

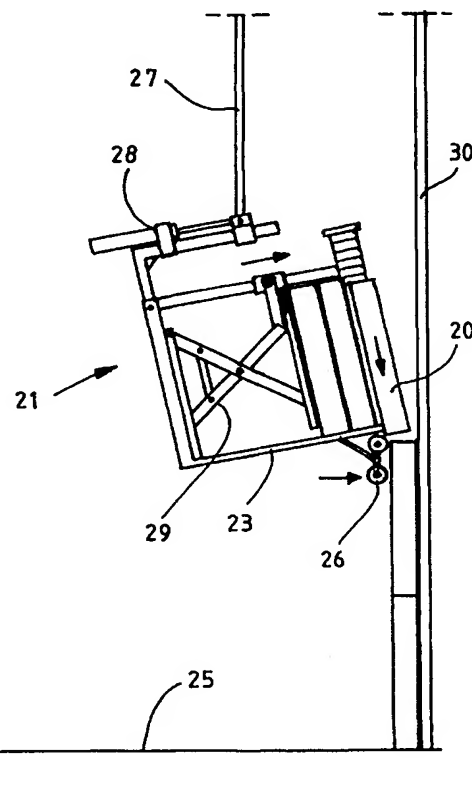


INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁷ : E04C 2/26, E04F 13/08, E04G 21/14	A1	(11) International Publication Number: WO 00/37747 (43) International Publication Date: 29 June 2000 (29.06.00)
(21) International Application Number: PCT/IB99/02035 (22) International Filing Date: 20 December 1999 (20.12.99) (30) Priority Data: 982754 18 December 1998 (18.12.98) FI 990117 21 January 1999 (21.01.99) FI (71)(72) Applicant and Inventor: INKEROINEN, Jukka [FI/FI]; Isoniityntie 17, FIN-21600 Parainen (FI). (74) Agent: PATENTTITOIMISTO KARI PIRHONEN OY; P.O. Box 71, FIN-20101 Turku (FI).		(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG). Published <i>With international search report.</i> <i>Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.</i> <i>In English translation (filed in Finnish).</i>

(54) Title: DEVICE FOR INSTALLING LIGHT-WEIGHT PANEL UNITS, INSTALLING DEVICE AND ATTACHING DEVICE**(57) Abstract**

A method for installing light-weight panels, according to which method the light-weight panel is mounted in its place on the wall or ceiling of a building and fastened there by a fastening member resting on or attachable to the edge portion of the light-weight panel. The light-weight panel installation apparatus incorporates a fastening device, such as a nail gun, by means of which the fastening member, resting on or attached to the edge of the light-weight panel, is fastened to a building frame. The panel fastening member incorporates a part resting on the edge of the light-weight panel, which part can, directly or by means of an intermediate member, be fastened to a base, such as a building frame.



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DEVICE FOR INSTALLING LIGHT-WEIGHT PANEL UNITS, INSTALLING DEVICE AND ATTACHING DEVICE

An object of this invention is a method for installing light-weight panels, according to
5 which method the light-weight panel is installed in such a way that it is moved to the point
where it is to be installed, which may be a wall or ceiling of a building, and fastened to a
base, such as a building frame or similar, in which installation at least one fastening
member is employed.

10 The light-weight panels generally used in building are wall or ceiling panels with an
insulating wool core sandwiched between two thin steel sheets. Usually tongues or
grooves have been formed on the long sides of the panels by bending the edges of the
face sheet appropriately. The panels are installed so that their corresponding tongues and
grooves are fitted together.

15 The fastening of a light-weight panel to a wall frame is usually performed in such a way
that an installation worker drills a hole in the light-weight panel with a drilling machine,
after which the installation worker drives a screw into the hole, which screw locks this part
of the light-weight panel to a vertical beam in the wall of the building. Such a panel
20 fastening method, however, has numerous disadvantages.

One disadvantage of the screw fastening method is the screw itself, i.e. the fact that the
fastening screws remain visible in the otherwise smooth steel sheet surface of the panel.
A more serious problem, however, is the fact that the screw fastening is inflexible. It does
25 not yield or allow for deformations caused by thermal expansion of the panel. For this
reason, flexible washers have to be used underneath the screw-heads. This does not
always help, either, since as the sheet expands and becomes thicker because of heat,
the screw-heads tend to press into the panel's face sheet. When the panel contracts, the
screw-heads protrude from the face of the panel sheet and the panel fastening remains
30 loose.

It is even more difficult to accommodate the panel's longitudinal thermal expansion with
the screw fastening method. When the ends of the panel have been locked in place with
screws, longitudinal thermal expansion of the panel causes it to curve. In other words, the
35 centre of the panel arches and bulges outward.

A further disadvantage of the known installation methods is the fact that they are slow and therefore expensive. The lifting and positioning of panels and the fastening of screws are slow procedures, since the installation personnel have to move with the panel to each respective fastening point. It is not possible with known personnel hoists to move quickly
5 from one point to another.

The aim of this invention is to produce a light-weight panel installation method which lacks the above-mentioned disadvantages. A further aim of the invention is to produce a panel installation method that allows fast and reliable concealed fastening of panels without the
10 need to use any installation personnel for the fastening. It is characteristic of the method relating to the invention that the light-weight panel is installed by means of a fastening member resting on or attachable to the edge portion of a light-weight panel.

According to one preferred embodiment of the method relating to the invention, a part of
15 the fastening member shaped to match the edge, such as a tongued/grooved edge, is installed at the edge of the panel or in the gap between two panels.

According to a second preferred embodiment of the method relating to the invention, the fastening member is attached to the panel at the manufacturing stage to form a fixed part
20 of it.

According to a third preferred embodiment of the method relating to the invention, a non-fixed fastening member is attached to the panel at the installation stage.

25 According to a fourth preferred embodiment of the method relating to the invention, the fastening member is pushed into the panel's tongued/grooved edge from its end so that the barbs of the fastening member go underneath the edges of the panel's face sheet.

According to a fifth preferred embodiment of the method relating to the invention, the
30 fastening member is attached to an installation base, such as a building frame, after which the panel is mounted against the fastening member in such a way that the part of the fastening member shaped to match the tongued/grooved edge locks into the panel's tongued/grooved edge.

35 According to a sixth preferred embodiment of the method relating to the invention, two fastening members are attached to a building frame, the panels are mounted against

these, and then a locking connector is pressed between the fastening members, so that the fastening members lock into the tongued/grooved edges of the panels.

5 According to a seventh preferred embodiment of the method relating to the invention, the panel to be installed is placed between fastening members attached to a building frame, which are then locked to the tongued/grooved edge of the panel.

10 According to an eighth preferred embodiment of the method relating to the invention, the panel to be installed is pressed, by gravity or with the help of a pushing member, against the next panel and the fastening member between the panels, whereby the fastening member is locked into the tongued/grooved edges of both adjacent panels.

15 According to a ninth preferred embodiment of the method relating to the invention, the panel to be installed is guided between fastening members attached to a building frame, the first fastening member being locked to the edge of the first panel and the second fastening member being locked to the edge of the second panel.

20 According to a tenth preferred embodiment of the method relating to the invention, when installing the panels, the intermediate storage unit is tilted into such a position that the panels stacked in the storage unit are mainly parallel with the plane of the installation base, or at a small angle to it, after which the intermediate storage unit is moved along parallel with the base, and that, when the panels are installed successively, they are moved in the intermediate storage unit towards the installation base.

25 According to an eleventh preferred embodiment of the method relating to the invention, the fastening member is locked with at least one screw to the tongued/grooved edge of the previously installed panel, so that the screws are concealed between the tongued/grooved edges of two adjacent panels.

30 According to a twelfth preferred embodiment of the method relating to the invention, the panel is moved by lifting it by at least one fastening member attached to the panel.

35 According to a thirteenth preferred embodiment of the method relating to the invention, the panel is attached to a building frame by the flange part of the fastening members.

According to a fourteenth preferred embodiment of the method relating to the invention, a securing nail is driven through the flange part of the fastening member to a frame beam or similar of a building.

5 According to a fifteenth preferred embodiment of the method relating to the invention, when installing the panel, a nail gun is positioned near at least two fastening members, so that the nail guns are aimed at the fastening flanges of the fastening members, and that the panel, fastening members and nail guns move as one package when the panel is moved to its proper installation point, after which the panel is locked into place by
10 activating the nail guns by remote control.

An advantage of this installation method is that no electric cables are required at the installation site. The nail gun is fired by a powder charge, which produces a highly reliable fastening. The installation is also very fast, since no installation personnel are needed.
15 Furthermore, using the gun is substantially faster than fastening a screw. Also, no specially designed hoist is needed for the installation, if the panel is lifted by the lifting eyes on the fastening members.

Another object of this invention is an installation apparatus for installing the light-weight
20 panels. It is characteristic of the installation apparatus relating to the invention that the installation apparatus comprises a fastening device which can be aimed at the fastening member of the panel to be installed for fastening the light-weight panel to a base, such as a building frame.

25 The fastening device is most advantageously a remotely operated fastening device, such as a nail gun, which is in conjunction with a panel fastening member, aimed at the fastening flange of the fastening member ready to be activated when the panel is in place. In this way the panel fastening member can be locked into place in a building frame without installation personnel.

30 According to one preferred embodiment of the installation apparatus relating to the invention, the installation apparatus incorporates a magazine of fastening members, from which a fastening member can be moved to the installation point before the panel is installed.

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According to a second preferred embodiment of the installation apparatus relating to the invention, the installation apparatus incorporates a camera for monitoring the position and functioning of the nail gun.

- 5 According to a third preferred embodiment of the installation apparatus relating to the invention, the installation apparatus incorporates a spirit level or similar for adjusting the panel to the horizontal before fastening.

- 10 According to a fourth preferred embodiment of the installation apparatus relating to the invention, the installation apparatus incorporates an intermediate storage unit and members for turning the storage unit so that the panels are mainly parallel to the installation surface or at a small angle to it.

- 15 According to a fifth preferred embodiment of the installation apparatus relating to the invention, the installation apparatus incorporates members for moving the intermediate storage unit along parallel with the installation base, and a support roller or similar, which presses the installed panel against the building frame.

- 20 According to a sixth preferred embodiment of the installation apparatus relating to the invention, the installation apparatus incorporates members for moving the panels in the intermediate storage unit towards the installation base every time the panel closest to the surface has been installed.

- 25 A further object of this invention is a novel panel fastening member. It is characteristic of the fastening member relating to the invention that the fastening member comprises a part resting on the edge of the light-weight panel, which part can be fastened to a base, such as a building frame, either directly or using an intermediate member.

- 30 Most advantageously, the part joining the edges of the face sheets of the panel is mainly shaped to match the edge of the panel, such as a tongued/grooved edge, so that this part can be positioned against the tongued/grooved edge or in the gap between the tongued/grooved edges of two adjacent panels.

- 35 According to one preferred embodiment of the fastening member relating to the invention, the fastening member incorporates at least two holders, such as barbs, which can be positioned underneath the edge portions of the panel's face sheets so that the fastening member can be joined to the edge, such as a tongued/grooved edge, of a panel.

According to a second preferred embodiment of the fastening member relating to the invention, the part of the fastening member connecting the edge portions of the panel's face sheets to each other has been attached to the edges of the panel's face sheets by a spot welded or similar joint.

According to a third preferred embodiment of the fastening member relating to the invention, the part of the fastening member connecting the edge portions of the panel's face sheets to each other incorporates a hole for a lifting device or for aligning fastening devices, such as nail guns.

According to a fourth preferred embodiment of the fastening member relating to the invention, the fastening member incorporates a flange part, mainly parallel to the surface of the panel, for attaching the fastening member to a building frame.

According to a fifth preferred embodiment of the fastening member relating to the invention, the flange part of the fastening member incorporates a hole for a lifting hook.

According to a sixth preferred embodiment of the fastening member relating to the invention, the installation member can be positioned in the gap between two adjacent panels to lock the panels in place.

According to a seventh preferred embodiment of the fastening member relating to the invention, the fastening member is a sheet-like piece, which has been bent mainly to match the shape of the tongued/grooved edge of the panel so that it fits into the tongue and groove joint between two adjacent panels and locks into the tongued/grooved edges of both panels when the panels are pressed together.

According to an eighth preferred embodiment of the fastening member relating to the invention, the fastening member between two panels incorporates at least two holding parts, the first of which is arranged so as to hold the edge of the first panel and the second of which is arranged so as to hold the edge of the second panel, and that the fastening member also incorporates at least one capping strip or wedge part positioned between the holding parts, by means of which capping strip or wedge part the holding parts can be pushed away from each other and pressed into place against the edges of the panels.

According to a ninth preferred embodiment of the fastening member relating to the invention, the fastening member is a combination fastener designed to fasten the corner of two adjacent panels, which fastening member also incorporates, in addition to two holding parts, two fastening members matching the shape of the tongued/grooved edge.

5

According to a tenth preferred embodiment of the fastening member relating to the invention, the fastening member is attached to a vertical beam of a building frame or similar by means of a fixed or flexible joint or a hinge.

10 According to yet another preferred embodiment of the fastening member relating to the invention, the fastening member is made of thin steel sheet or similar.

In the following, the invention is described using examples with reference to the appended drawings, in which

15

Figure 1 is a side view of a panel installation apparatus relating to the invention.

Figure 2 corresponds to figure 1 and illustrates a second embodiment of the panel installation apparatus.

Figure 3 shows a detail of figure 1.

20 Figure 4 illustrates the panel installation apparatus of figure 1 in a situation where ceiling panels are being installed.

Figure 5 corresponds to figure 4 and is a view of the second stage of ceiling panel installation.

Figure 6 corresponds to figure 4 and is a view of the third stage of ceiling panel installation.

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Figure 7 shows a detail of the installation in figure 5.

Figure 8 is an axonometric view of a panel fastening member relating to the invention.

Figure 9 is a side view of the panel fastening member in figure 8.

Figure 10 corresponds to figure 9 and illustrates a second embodiment of the fastening member.

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Figure 11 illustrates a panel and its fastening member.

Figure 12 illustrates alternative panel fastening options.

Figure 13 illustrates yet another panel fastening method.

Figure 14 illustrates the fastening of panels and a third embodiment of the fastening member.

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Figure 15 illustrates a strip belonging to the fastening member in figure 14.

- Figure 16 illustrates the fastening member in figure 14 attached using the strip in figure 15.
- Figure 17 illustrates a fourth embodiment of the panel fastening member.
- Figure 18 illustrates the fastening of panels using the fastening member in figure 17.
- 5 Figure 19 illustrates the placing of panels and fastening members.
- Figure 20 corresponds to figure 17 and illustrates a fifth embodiment of the panel fastening member.
- Figure 21 corresponds to figure 18 and illustrates a sixth embodiment of the fastening member.
- 10 Figure 22 illustrates a third panel fastening method.
- Figure 23 illustrates a fourth panel fastening method.
- Figure 24 illustrates a fifth panel fastening method.
- Figure 25 illustrates a panel installation apparatus according to a second embodiment.
- Figure 26 illustrates a panel installation apparatus according to a third embodiment.
- 15 Figure 27 corresponds to figure 2 and illustrates a panel installation apparatus according to a fourth embodiment.
- Figure 28 illustrates an embodiment of the panel fastening member.
- Figure 29 illustrates a panel lifting method.
- Figure 30 illustrates another panel lifting method.
- 20 Figure 31 illustrates an embodiment of the panel installation member.

Figure 1 illustrates a panel 20 installation apparatus 21 connected to a forklift truck 22. The installation apparatus 21 incorporates an intermediate storage unit 23, in which the panels 20 to be installed on a wall or a ceiling are stacked. The intermediate storage unit

25 23 is suspended from an axle 24 so that the panels 20 can be aligned with the wall or ceiling on which they are to be installed. The installation of the panels 20 commences from the side of the stack which in figure 1 is towards the ground 25. Figure 1 also illustrates feeding devices needed in the installation and the support rollers 26 which press against the already panelled sections of wall or ceiling. Their use is illustrated in

30 more detail in the following figures.

Figure 2 illustrates a panel 20 installation apparatus 21 connected to a cable 27 of a crane. At the intersection of the cable 27 and the installation apparatus 21 is placed a balancing cylinder 28, by means of which the position of the cable's 27 fulcrum point can

35 be changed. In this way the installation apparatus 21 can be tilted into the inclined position illustrated in figure 2, which makes the installation of panels 20 easier.

In figure 2, the installation of panels 20 has been commenced from the bottom of the wall. The installation takes place so that the installation apparatus is lifted by the cable 27 of the crane each time a panel 20 has been installed. The entire apparatus rests on the completed wall section, mediated by the support roller 26. When the installation apparatus 21 has been lifted slightly above the installed panel 20, the pantograph 29 incorporated in it presses the panel stack in the intermediate storage unit 23 towards the wall. Thus the panel 20 closest to the beam 30 functioning as an installation base drops from the installation apparatus 21 by force of its own weight onto the panel previously installed against the beam 30. Even though the falling panel 20 is initially slightly tilted away from the beam 30, the panel to be installed automatically turns into a vertical position against the beam 30.

Figure 3 shows a detail of figure 2, in which the support roller 26 is illustrated along with the equipment that guides the panel to be installed to the correct position on top of the previously installed panel and its tongued edge. The guiding equipment incorporates a small roller 31, which in the situation illustrated in figure 3 is located in the gap between the panels. When a panel 20 drops into place for installation, the panel 20 pushes the roller 31 out of the gap. The roller 31 can be connected e.g. to a micro switch, which can signal successful installation. Then the installation apparatus 21 can be lifted again by the height of a panel.

Figures 4-6 provide a serial illustration of the installation of panels on a ceiling. Figure 4 illustrates a situation where the previous panel has just been installed and the installation of the next one is being prepared. The forklift truck has moved to the point where the next panel is to be installed. In figure 5 the intermediate storage unit has been slightly tilted so that the panel 20 slides into its place in the right position, avoiding the fastening members 32 which have been placed in advance in the correct locations on the ceiling. In figure 6 an extensible arm 33 presses the panel 20 into its final place. Figure 7 illustrates a structural detail of this pushing arm 33, equipped with an articulated joint 34.

Figure 8 is an axonometric illustration of an embodiment of the panel fastening member 32. This fastening member 32 is most advantageously made of one steel sheet and shaped to match the tongues of the panel. The ridges 34a and 34b correspond to the tongues of the panel. The fastening member 32 is meant to be attached to the construction base, such as a wall beam, by its broader side 35 by means of a screw, rivet or by welding.

Figure 9 illustrates the panel fastening member 32 of figure 8 seen from the side. In this embodiment, the fastening area 35 for the screw 36 is relatively short. Figure 10 illustrates another embodiment in which the fastening area 35 is long. A long fastening area 35 makes the fastening of the fastening member 32 flexible. Such a long part operates like a spring, preventing thermal stress from putting strain on the installed panel.

Figure 11 illustrates a situation where the panel 20 is pressed into place and locked by means of the locking member 32. It can be seen from figure 11 that when the panel 20 is pressed against the wall beam 30, the tongue 37b of the panel locks into the groove on the opposite side of the ridge 34b of the locking member 32. Thus it is not necessary to lock the panel 20 by other means at the installation stage. When the next panel in turn comes on top of the fastening member 32, the fastening member 32 is tightly pinned in the gap between the panels. The shape of the fastening member 32 matching the tongues and grooves of the panels ensures that it will not slip out of the gap and that the fastening will hold tight.

Nevertheless, figure 12 illustrates the possibility of an additional, reinforcing screw fastening. If desired, screws can be fastened to points 38a, 38b and 38c. The screws are concealed inside the tongue and groove joint after the next panel is laid on top of the fastening member 32.

Figure 13 illustrates another screw fastening option. The screw 38d can even be added afterwards. It is neatly concealed if the screw 38d is fastened through a hole 39 made in the outer face sheet of the panel 20b. After fastening the screw, the hole 39 can be covered by a plastic cap 40.

Figure 14 illustrates a second embodiment of the panel fastening member. In this case, the fastening member 41 attached to the wall beam 30 incorporates two separate holding parts 41a and 41b, which are both concealed in the gap between the panels 20a and 20b. When the panels 20a and 20b are in place, the capping strip 42 illustrated in figure 15 is pressed between the holding parts 41a and 41b. The capping strip 42 pushes the holding parts 41a and 41b away from each other, whereby they are tightly pressed against the edges of the panels 20a and 20b. At the same time, the holding hooks 43a and 43b are locked to the edge portions of the panels 20a and 20b.

Figure 16 illustrates a situation where the fastening member 41 has locked the panels 20a and 20b into place. Notches 44a-d have been formed both in the capping strip 42 and in

the holding hooks 43, causing the capping strip 42 to click into place like a press stud when pressed. The seals 45a-d ensure that the joint is also fairly well watertight.

Figure 17 illustrates a third embodiment of the panel fastening member. In this
5 embodiment, both the fastening members 32a and 32b to be connected to the
tongued/grooved edge and the holders 41a and 41b to be fitted between the panels are
joined to the same base plate 46a. This kind of combination fastening member 46 can be
used for instance for wall structures at points where panels intersect at corners. Thus the
same fastening member can be used to lock two adjacent panels, both on two different
10 sides, as illustrated in figure 18.

In practice the whole intersection of four panels is locked very reliably. The tongue and
groove joint in itself forms a good lock, if the elements otherwise remain in place.
However, if desired, to secure such an intersection fastening, a fastening member formed
15 only of holders 41a and 41b can be placed on top of it. Such a fastening solution is
illustrated in figure 19.

Figure 20 illustrates a fifth embodiment of the panel fastening member, which functionally
corresponds to figure 17. It is, however, simpler in structure, because the fastening
20 member in figure 20 is made of a single sheet by cutting and bending. In the fastening
member in figure 17, the holding parts 41a and 41b are joined to the base plate 46 for
instance by welding.

Figure 21 illustrates a sixth embodiment of the panel fastening member 32, in which the
25 flange 35 to be fastened to the building's frame structure is positioned vertically. In
addition, at both ends of the flat part 47 between the ridges 34a and 34b there are barbs
48, which are used to attach the fastening member 32 to the tongued edge of a light-
weight panel, as illustrated in figures 23 and 24.

Figure 22 illustrates a fastening method for the panel 20 with a fastening member 32 as in
figure 21. In this situation, the panel 20 is the bottom-most panel of the wall structure,
underneath which there is no support balk or other similar support. In this situation the
fastening member 32 is first attached to the desired level on the vertical beam 30 of the
building by means of screws or nails 36. After this the panel 20 can be lowered on top of
35 the fastening member 32. After this the bottom edge of the panel 20 is locked in place
with a screw 38, which fastens the tongued/grooved bottom edge of the panel 20 to the

fastening member 32. The top edge of the panel 20 is locked by a similar fastening member 32, as illustrated in more detail in the following figures.

Figure 23 illustrates the fastening of the top edge of the panel 20 to the vertical beam 30 of a building frame, using a fastening member 32 as shown in figure 21. The fastening member 32 has been attached to the tongued top edge of the panel 20 before the panel is brought to the installation site. The fastening to the tongued edge of the panel 20 has been effected by pushing the fastening member 32 into place from the end of the tongued edge in the direction of the tongued edge of the panel 20. Thus the barbs 48a and 48b of the fastening member 32 go underneath the edges 50a and 50b of the face sheets 49a and 49b of the panel 20. The insulating wool 51 between the face sheets 49a and 49b of the panel 20 keeps the fastening member 32 well in place during the lifting and installation of the panel 20. If necessary, silicone or another fastening medium can naturally be used to ensure the fastening of the fastening member 32 in addition to or instead of the barbs 48a and 48b. The lifting of the panel 20 into place can be effected by a suction pad 52, as in figure 23, or by some other lifting member, as illustrated in the following figures.

The attachment of the panel 20 fastening member 32 to the vertical beam 30 of a building frame is effected by means of screws, nails or welding. Figure 23 illustrates a nail gun 53, which can be activated to drive a nail to lock the fastening member 32 to the vertical beam 30. The installation can be carried out in such a way that the nail gun 53 is already placed on top of the fastening member 32 attached to the tongued edge of the panel 20 when starting to lift the panel 20. Then, when the panel 20 is in place against the beam 30 of a building frame, the nail gun 53 is also automatically in the correct position and can be activated immediately to fasten the panel 20. The essential feature is that no installation personnel is needed to fasten the panel 20, because the person operating the panel 20 lifting apparatus can activate the nail gun or other fastening device by remote control. If necessary, proper functioning can be monitored by means of a video camera or similar.

After this, the panel 20 is securely locked into place by both its bottom and top edge. Furthermore, the barbs 48a and 48b of the top fastening member 32 add to the reliability of the top fastening. They keep the fastening member 32 securely locked to the tongued top edge of the panel 20 even if no further panels are placed on top of the fastening member 32. The barb 48a on the beam 30 side also operates as an additional reinforcement of the fastening of the panel 20.

Figure 24 illustrates the intermediate storage unit of the panels 20, with fastening members 32 as shown in figure 21 attached to the tongued top edges of the panels 20. However, the panels 20 do not necessarily have to be in an intermediate storage unit nor even in a horizontal position. All kinds of installation methods are possible. The essential
5 feature is that the fastening members 32 can be attached to the panels 20 well in advance before the actual installation of the panels. According to the preferred embodiment featured in figure 24, the fastening members 32 have been pushed into place on the panels 20 from their ends in the direction of their tongued edges so that the barbs 48a and 48b of the fastening members 32 go underneath the face sheets 49a and
10 49b in the tongued edge of the panel 20. Closer details are illustrated in figure 23.

Figure 24 shows the uppermost panel 20 being lifted by suction pads 52 of the lifting apparatus 21. However, the fastening member 32 remains securely in place during the lifting and installation, because the barbs 48a and 48b of the fastening member 32 are
15 pressed between the edges of the face sheets 49a and 49b of the panel 20 and the insulating wool 51 of the panel 20.

Furthermore, figure 24 shows that the installation apparatus 21 lifting the panel 20 incorporates a nail gun 53, by means of which the panel is fastened to a beam of a
20 building frame or similar. The nail gun 53 is connected to the installation apparatus 21 by intermediate members, with which the position of the nail gun 53 in respect to the panel 20 can be altered. In figure 24, the nail gun 53 has already at an initial stage of lifting been moved to rest against the tongued edge of the panel 20 and the fastening member 32. Thus the nail gun 53 is already in its proper position by the fastening member 32,
25 which means that the fastening to the beam of a building frame can be carried out as soon as the panel 20 is in place.

Figure 25 illustrates a panel installation apparatus 21, which incorporates suction pads 52 for gripping the panel 20. In figure 25, the panel 20a has just been lifted and mounted in
30 place on top of the lower panel 20b. The installation apparatus 21 incorporates a spirit level or similar 54, with the help of which the horizontal position of the panel 20 can be checked and adjusted. The installation apparatus illustrated in figure 25 also incorporates video cameras 55a and 55b, with the help of which the correct aim of the nail guns 53a and 53b can be checked. When the panel 20 is correctly positioned and in the right place
35 against the vertical beams 30a and 30b, the operator of the installation apparatus 21 activates the nail guns 53a and 53b positioned at the fastening members 32a and 32b of the panel 20. The panel 20 is now locked into place and the next panel can be mounted.

- Figure 26 illustrates a panel installation apparatus 21, which incorporates edge lifters 56a and 56b for gripping the panel 20. Also incorporated in the installation apparatus 21, in conjunction with the edge lifters 56a and 56b, are video cameras 55a and 55b and nail guns 53a and 53b. These are remotely operated so that the operator of the installation apparatus 21 can activate the nail guns 53a and 53b and lock the panel 20 in place without the need for a separate installation worker to perform this task as in current practice.
- Figure 27 illustrates a panel installation apparatus 21 with panels 20 in vertical position in the intermediate storage unit. At both ends of the upper tongued edges of these panels 20 there are already fastening members 32 attached. The installation apparatus 21, suspended from a cable 27, is moved to the installation point, after which the pantograph 29 pushes the panels, feeding the outermost panel 20 against the vertical beams 30. When the panel 20 is in place, securing nails are driven in with the help of the nail guns 53, locking the fastening members 32 and thus the top of the panel 20 to the vertical beams 30. The video cameras 55 can be used to check the correct positioning of the securing nails.
- Figure 28 illustrates an embodiment of the panel 20 fastening member 32, which has been fixed to the tongued edge of the panel by spot welding 57 already at the panel manufacturing stage. Since the welded joint 57 is substantially stronger than the joint illustrated in figure 23 created by barbs 48, the fastening member 32 can also be used for lifting the panel 20 during transport and installation stages. Thus the fastening member 32 relating to this embodiment is a combined fastening and lifting member. For the purpose of lifting the panel, the fastening member 32 incorporates a hole 58, which is located in one side of the flange part 35 in order to leave space for a securing screw or nail in the other side of the flange 35. Fastening members 32 as shown in figure 28 can be placed on the long side of the panel 20 at any point on the tongued edge depending on the desired number of points at which the panel 20 is to be fastened to a building frame.
- Figure 29 illustrates a method for installing the panel 20, by which method the panel 20, when being installed, is lifted by the combined fastening and lifting members 32a and 32b as illustrated in figure 28. In these fastening members 32a and 32b the holes for the lifting hooks 59a and 59b are located at the inner sides of the fastening flanges 35 so that sufficient free space remains at the outer sides of the flanges 35 for fastening the flanges 35 by screws or nails to the vertical beams 30a and 30b.

Figure 30 shows as a vertical section along the tongued edge a detail of the panel 20 illustrated in figure 28 and the fastening and lifting member 32 spot welded to it. For the purpose of lifting the panel 20 during the installation stage, a plate-like lifting hook 59 has been inserted beneath the level part 47 of the fastening member 32 between the tongues, between the edges 50 of the panel's face sheets. The lifting hook 59 remains securely in place during lifting, as it is pressed between the level part 47 of the fastening member 32 and the insulating wool 51 of the panel 20.

Figure 31 illustrates a lifting and support member 60 placed in the centre of the long side of the panel 20, on the tongued edge, which member has been joined by spot welding 57 to the edges 50a and 50b of the face sheets 49a and 49b of the panel 20. This lifting and support member illustrated in figure 31 is in principle like the embodiment shown in figure 28, equipped with a flange 35. However, the lifting and support member 60 as in the embodiment illustrated in figure 31 is intended solely for the purpose of supporting and lifting the panel, for which reason no fastening flange 35 is required. Instead, an opening 61 has been made in the middle of the level part 47 of the lifting and support member 60, by which opening the panel 20 can be lifted. However, the panel 20 can also be lifted from underneath the edges 50a and 50b of the face sheets 49a and 49b, since the lifting and support member 60 has the effect of forming a reinforced lifting point in the adjacent area.

It is obvious to a person skilled in the art that the different embodiments of the invention may vary within the scope of the claims presented below.

CLAIMS

1. A method for installing light-weight panels (20), according to which method the light-weight panel is installed in its place at an installation point, such as a wall or ceiling of a building, and fastened to a base, such as a building frame (30) or similar,
5 c h a r a c t e r i s e d in that the light-weight panel (20) is installed using a fastening member (32, 41) resting on or attachable to the edge portion of the light-weight panel.
2. A method according to claim 1, c h a r a c t e r i s e d in that a part of the fastening
10 member (32) shaped to match the tongued/grooved edge of the panel is connected to the edge of the light-weight panel (20) so that in installation it is pinned in the gap between two adjacent panels.
3. A method according to claim 1 or 2, c h a r a c t e r i s e d in that a non-fixed fastening
15 member (32) is attached to the light-weight panel (20) in advance or at the panel installation stage.
4. A method according to claim 1, 2 or 3, c h a r a c t e r i s e d in that the fastening
20 member (32) is pushed into the tongued edge of the panel (20) from the end so that the barbs (48) of the fastening member go underneath the edges (50) of the panel's face sheet (49).
5. A method according to claim 1 or 2, c h a r a c t e r i s e d in that the fastening
25 member (32) is attached to the light-weight panel (20) at the manufacturing stage to form a fixed part of it.
6. A method according to claim 1, c h a r a c t e r i s e d in that a fastening member (332) is attached to the frame (30) of a building, which fastening member incorporates a part shaped to match the tongued/grooved edge of the light-weight panel (20) against which
30 part the panel is mounted.
7. A method according to claim 6, c h a r a c t e r i s e d in that the panel (20) to be installed is guided between fastening members (32, 41, 46) attached to a building frame (30), which fastening members are then locked to the tongued/grooved edge of the panel
35 (20a, 20b).

8. A method according to claim 6 or 7, c h a r a c t e r i s e d in that the panel (20b) to be installed is pressed, by force of gravity or with a pushing member, against the next panel (20a) and the fastening member (32) between the panels, whereby the fastening member is locked into the tongued/grooved edges of both adjacent panels.

5

9. A method according to claim 1, c h a r a c t e r i s e d in that at least two fastening members (41a, 41b) are attached to a building frame (30), which members have parts shaped to match the tongued/grooved edge of the light-weight panel, against which parts the panels (20a, 20b) are mounted, and that the fastening members are locked to the
10 tongued/grooved edges of the panels by pressing a connecting member (42) between the fastening members so that the fastening members are locked to the tongued/grooved edges of the panels.

10. A method according to any of the claims 1-9, c h a r a c t e r i s e d in that, when
15 installing the panels (20), the intermediate storage unit (23) is tilted into such a position that the panels stacked in the intermediate storage unit are mainly parallel with the plane of the installation surface (30), or at a small angle to it, after which the intermediate storage unit is moved along parallel to the surface, and that, as the panels are installed successively, they are moved within the intermediate storage unit towards the installation
20 surface.

11. A method according to any of the claims 1-10, c h a r a c t e r i s e d in that the fastening member (32) is locked with at least one screw (38) to the tongued edge of the previously installed panel, so that the screws are concealed between the
25 tongued/grooved edges of two adjacent panels (20a, 20b).

12. A method according to any of the claims 1-11, c h a r a c t e r i s e d in that the light-weight panel (20) is lifted by its surface with suction pads (52) or with one or more edge lifters (56a, 56b) by one or more fastening members (32).

30

13. A method according to any of the claims 1-12, c h a r a c t e r i s e d in that a securing nail is driven through the flange part of the fastening member (32) to a wall beam (30) or similar of a building.

35 14. A method according to any of the claims 1-13, c h a r a c t e r i s e d in that the light-weight panel (20) is attached to a building frame (30) by the flange part of the fastening member (32).

15. A method according to claim 14, characterised in that a securing nail is driven through the flange part of the fastening member (32) to a wall beam (30) or similar of a building.

5

16. A method according to any of the claims 1-15, characterised in that the fastening member (32) is fastened through a hole (39) made in the outer face sheet of the panel (20b), after which the hole is covered with a plastic cap (40).

10

17. An installation apparatus for installing light-weight panels (20), characterised in that the installation apparatus incorporates a fastening device (53) which can be aimed at the fastening member (32) of the panel (20) to be installed in order to fasten the light-weight panel to a base (30), such as a building frame.

15

18. An installation apparatus according to claim 17, characterised in that the installation apparatus incorporates at least one nail gun (53) or similar, by means of which the fastening member (32), resting on or attached to the edge of the light-weight panel (20), is fastened to the base (30), such as a building frame.

20

19. An installation apparatus according to claim 18, characterised in that the installation apparatus incorporates nail guns (53) positioned near one or more fastening members (32), which nail guns are aimed at the fastening flanges of the fastening member, and a remote control device for activating the nail gun.

25

20. An installation apparatus according to any of the claims 17-19, characterised in that the installation apparatus incorporates a camera (55) for monitoring the position and functioning of the nail gun (53).

30

21. An installation apparatus according to any of the claims 17-20, characterised in that the installation apparatus incorporates a spirit level (54) or similar for adjusting the panel (20) to the horizontal before fastening.

35

22. An installation apparatus according to any of the claims 17-21, characterised in that the apparatus incorporates an intermediate storage unit (23) and members (24) for turning the intermediate storage unit so that the panels (20) are mainly parallel to the installation surface or at a small angle to it.

23. An installation apparatus according to claim 22, characterised in that the apparatus incorporates members for moving the intermediate storage unit (23) along parallel to the installation surface, and a support roller (26) or similar, which presses the installed panel against the building frame (30).

5

24. An installation apparatus according to claim 22 or 23, characterised in that the apparatus incorporates members for moving panels (20) within the intermediate storage unit (23) towards the installation surface every time the panel closest to the surface has been installed.

10

25. A fastening member (32) for installing light-weight panels, characterised in that the fastening member (32) incorporates a part which rests on the edge of the light-weight panel, which part can be fastened to a base (30), such as a building frame, either directly or using an intermediate member.

15

26. A fastening member (32) according to claim 25, characterised in that the fastening member (32) incorporates a part which rests on the tongued edge of a light-weight panel (20) and a flange part which can be fastened to a base (30), such as a building frame.

20

27. A fastening member (32) according to claim 26, characterised in that the part of the fastening member (32) resting on the tongued edge of the light-weight panel (20) is mainly a sheet shaped to match the tongued edge, which sheet can, when installed, be placed in the gap between two adjacent light-weight panels to lock the panels in place.

25

28. A fastening member (32) according to claim 25, 26 or 27, characterised in that the fastening member (32) has been attached to the panel (20) by spot welded joints (57), which lock the edge portions (50) of the face sheets (49) of the panel together.

30

29. A fastening member (32) according to claim 28, characterised in that the fastening member (32) attached to the panel (20) incorporates a hole for a lifting device (58, 61) or for aligning fastening devices, such as nail guns (53).

35

30. A fastening member (32) according to claim 28, characterised in that the flange part of the fastening member (32) attached to the panel (20) incorporates a hole (58) or a lifting eye for a lifting hook.

31. A fastening member (32) according to claim 30, characterised in that the fastening member (32) attached to the panel is a combined fastening and lifting member, which incorporates a flange part incorporating both a lifting hole (58) and a fastening part, through which the securing nail can be driven to a frame beam (30) or similar of a building.
32. A fastening member (32) according to claim 25, 26 or 27, characterised in that the non-fixed fastening member (32) incorporates locking members, such as barbs (48), which go underneath the edges (50) of the face sheets (49) of the panel (20), by which barbs the fastening member can be fastened to the panel in advance or at the panel installation stage.
33. A fastening member (32) according to claim 25, 26 or 27, characterised in that the fastening device (32, 41, 46) is attached to a vertical beam (30) or similar of a building frame by means of a fixed or flexible joint or a hinge.
34. A fastening member (32) according to claim 33, characterised in that the fastening member (41) between two panels (20a, 20b) incorporates at least two holding parts (41a, 41b), of which the first holding part is arranged so as to hold the edge of the first panel and the second holding part is arranged so as to hold the edge of the second panel, and the fastening member also incorporates at least one locking connector (42) positioned between the holding parts, by means of which locking connector the holding parts can be pushed away from each other and pressed into place against the edges of the panels.
35. A fastening member according to claim 34, characterised in that the locking connector (42) of the fastening member (41) between the two panels (20a, 20b) is a capping strip (42), which clicks into place like a press stud.
36. A fastening member (32) according to claim 25, 26 or 27, characterised in that the fastening member (46) is a combination fastener designed to fasten the corner of two adjacent panels, which fastener incorporates, in addition to two holding parts (41a, 41b), also two fastening members (32) shaped to match the tongued/grooved edge.
37. A fastening member (32) according to any of the claims 25-36, characterised in that the fastening member (32, 41, 46) is made of thin steel sheet.

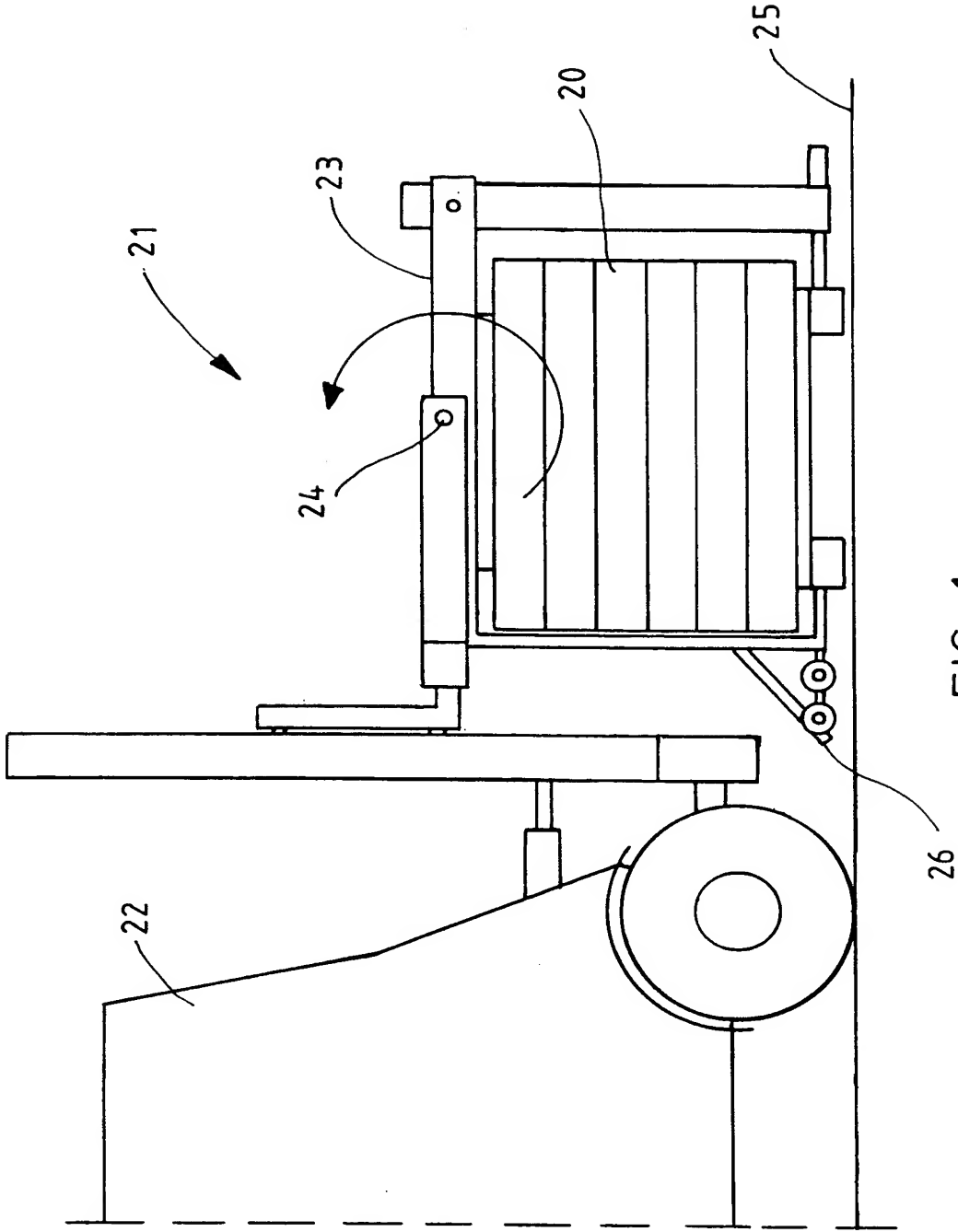


FIG. 1

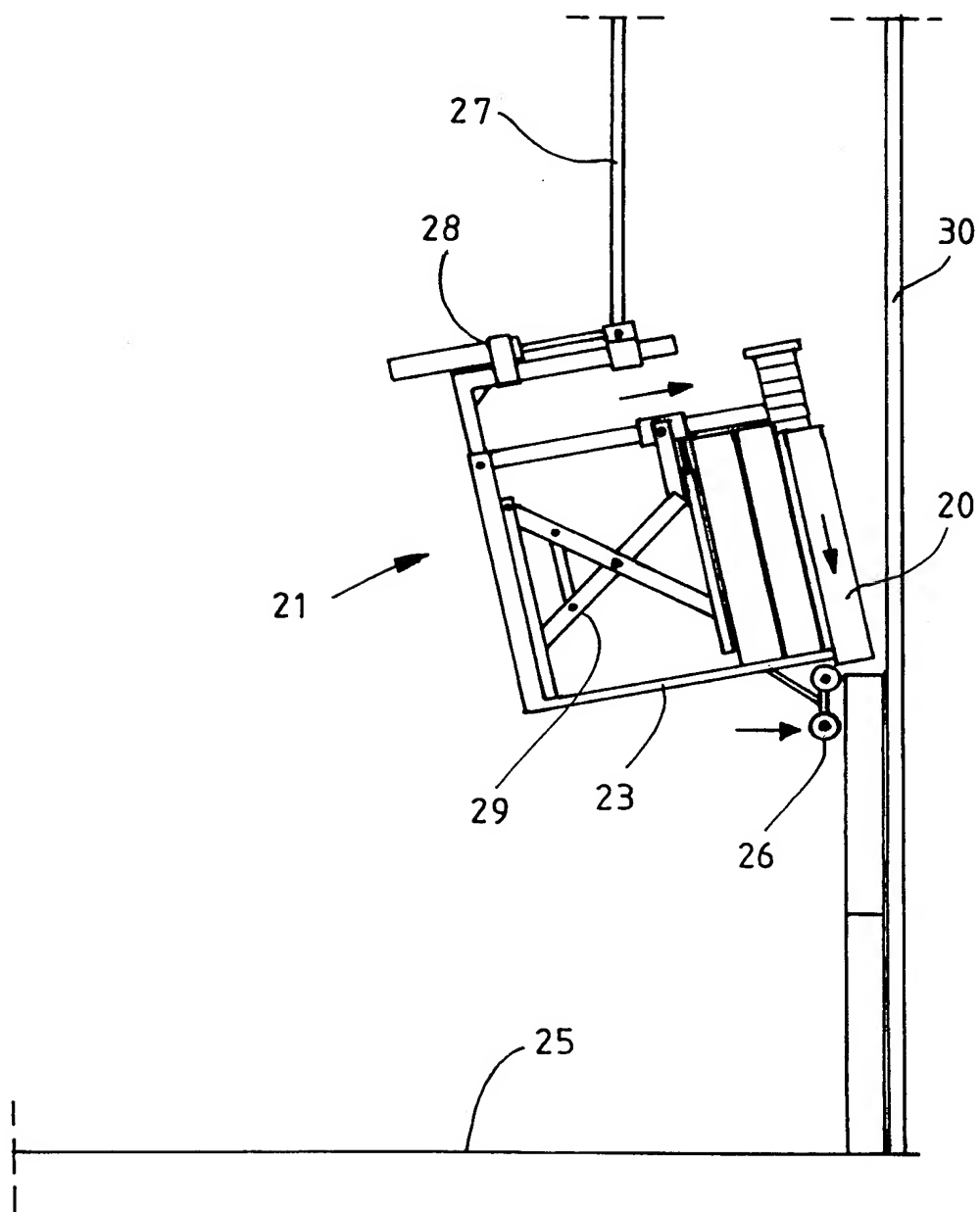


FIG. 2

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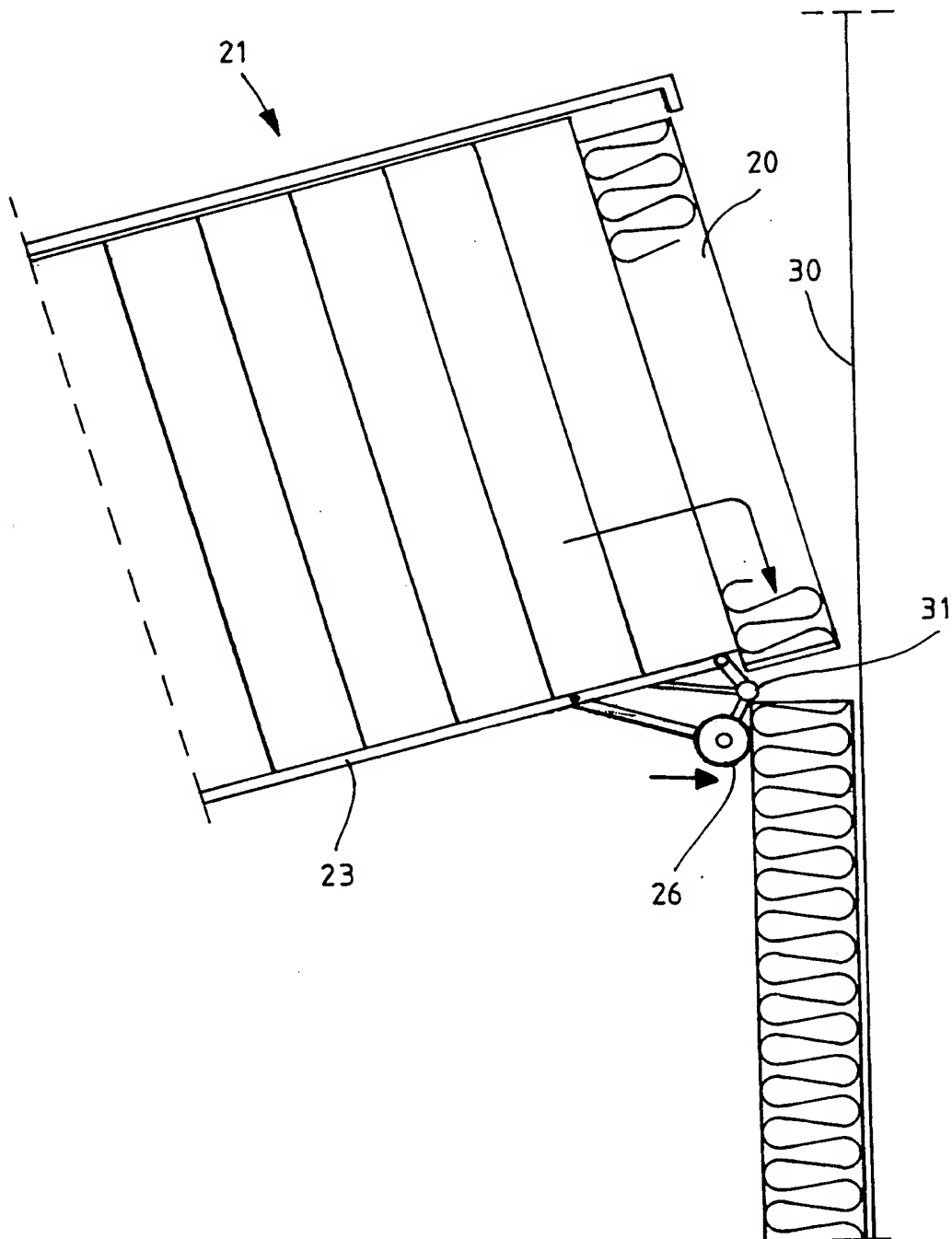


FIG. 3

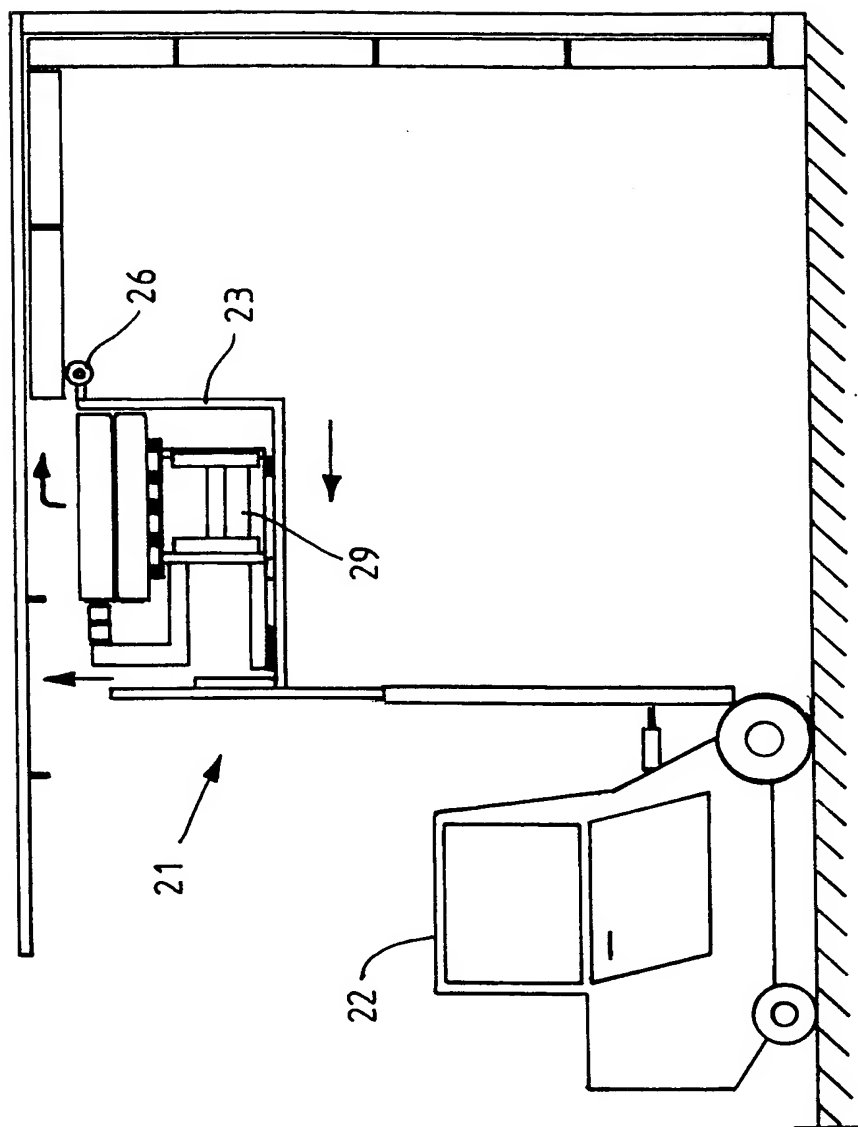


FIG. 4

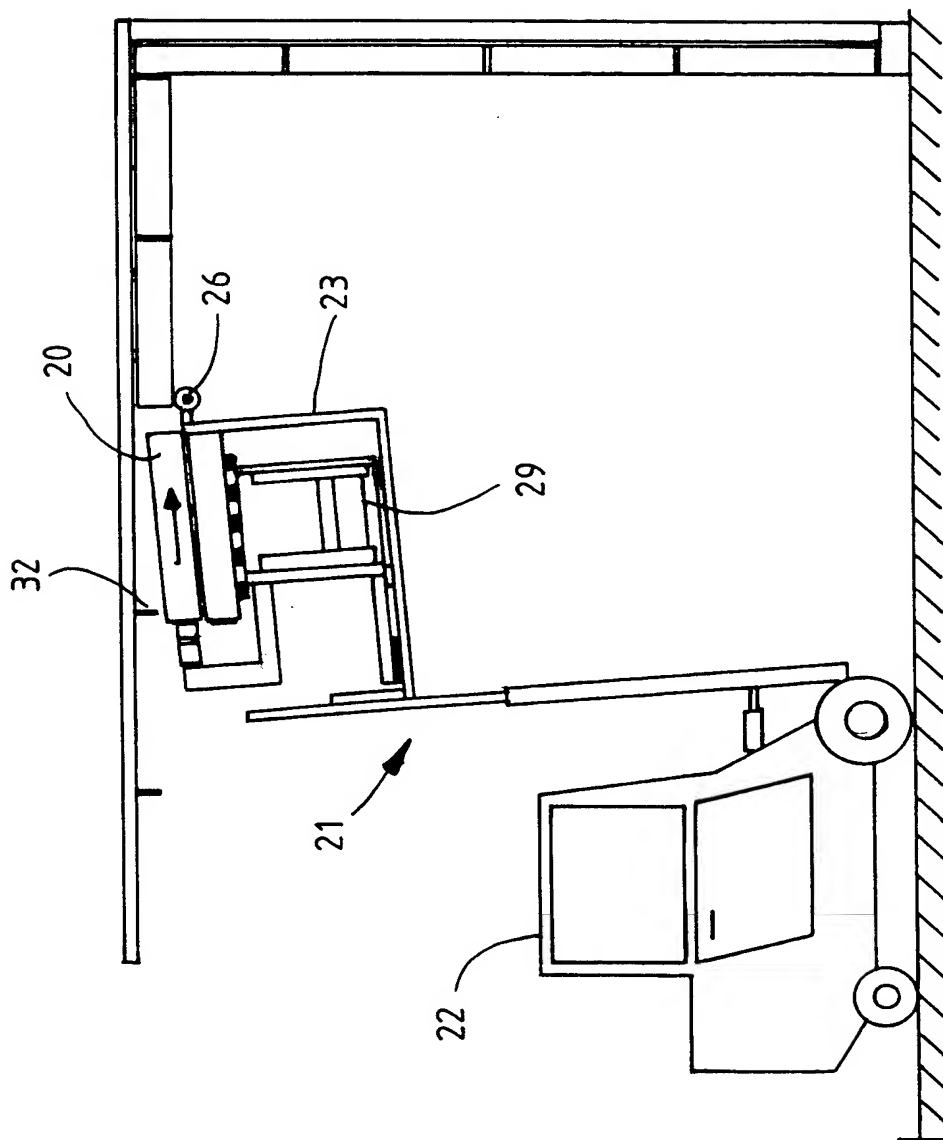


FIG. 5

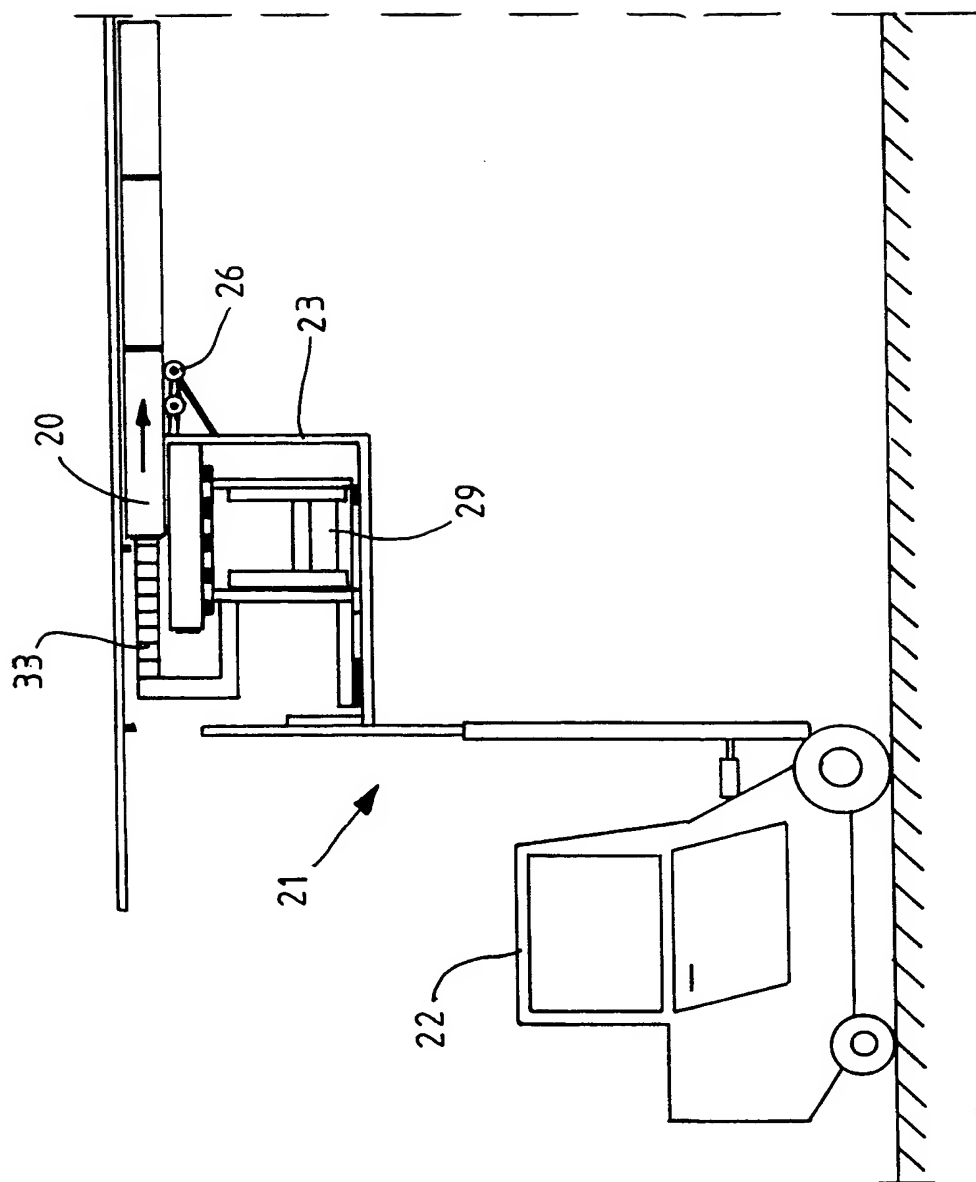


FIG. 6

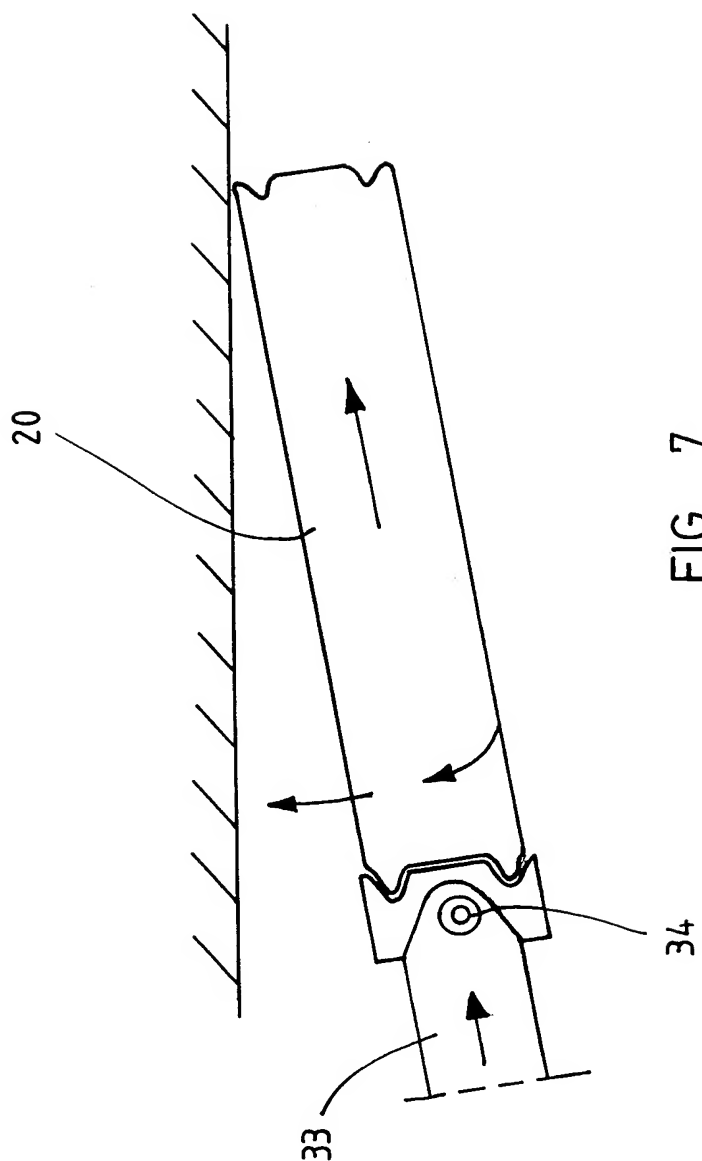


FIG. 7

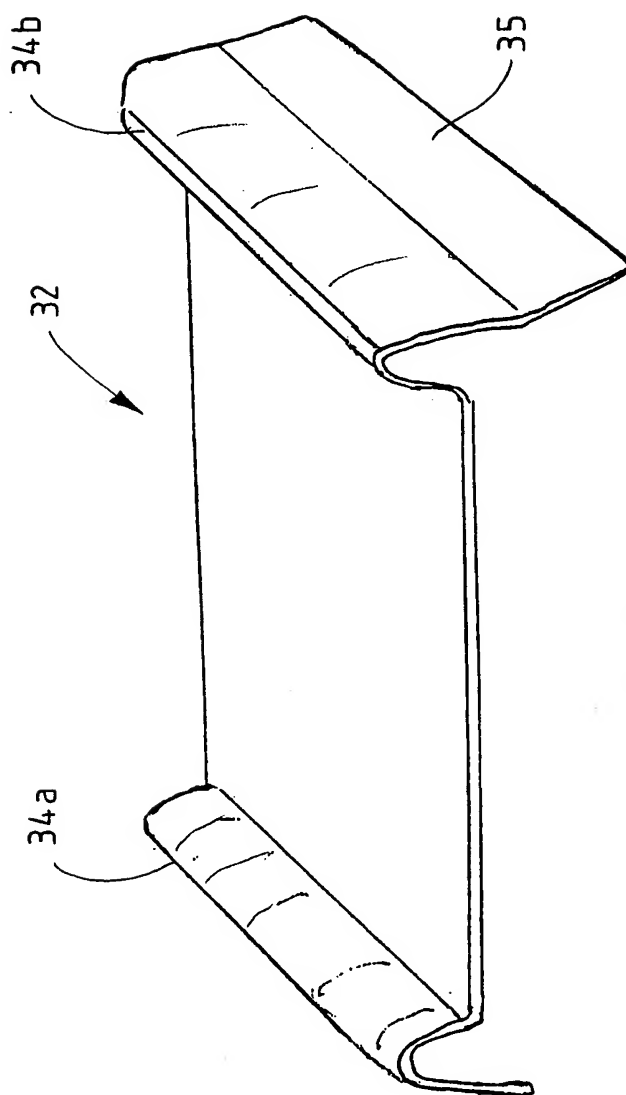
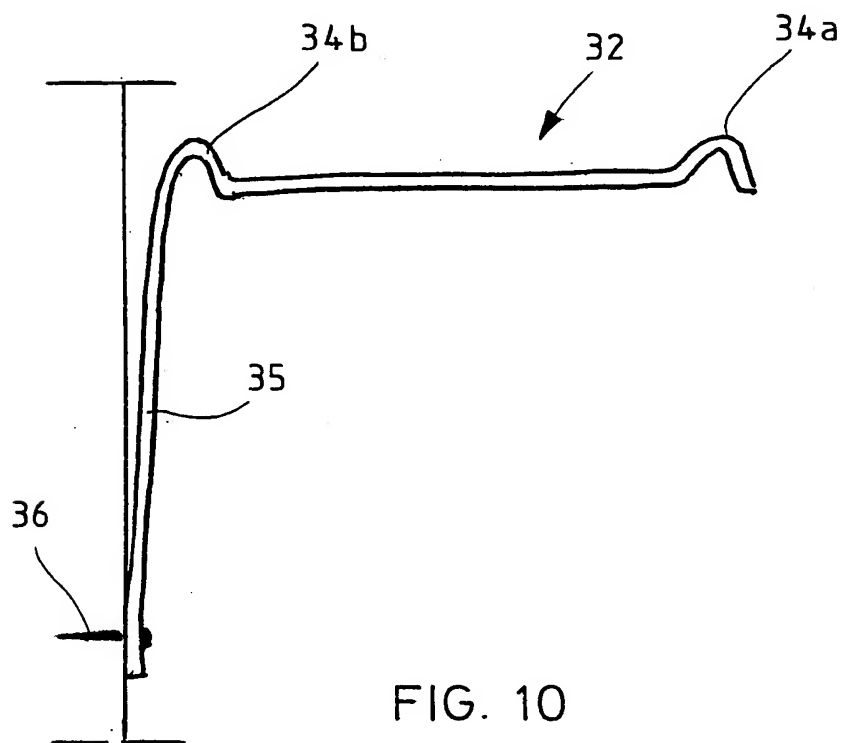
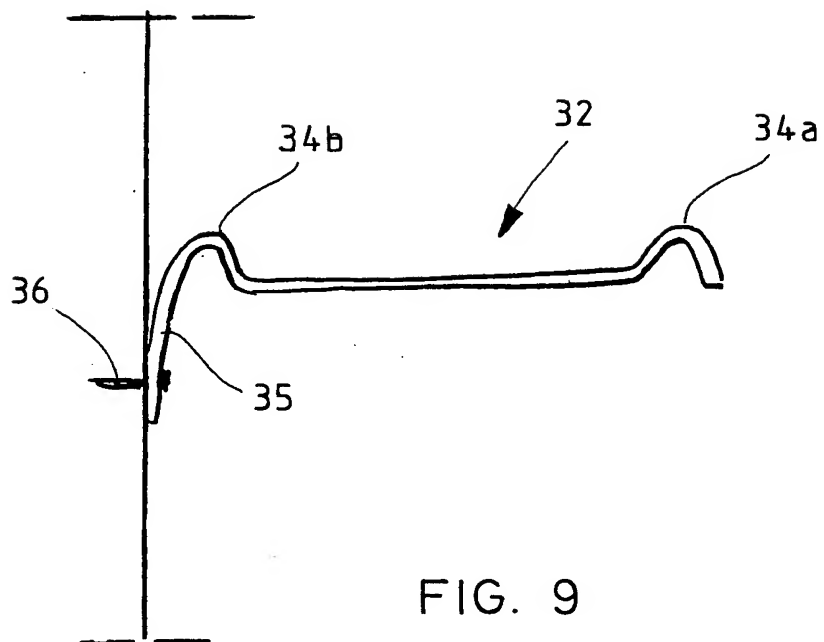


FIG. 8

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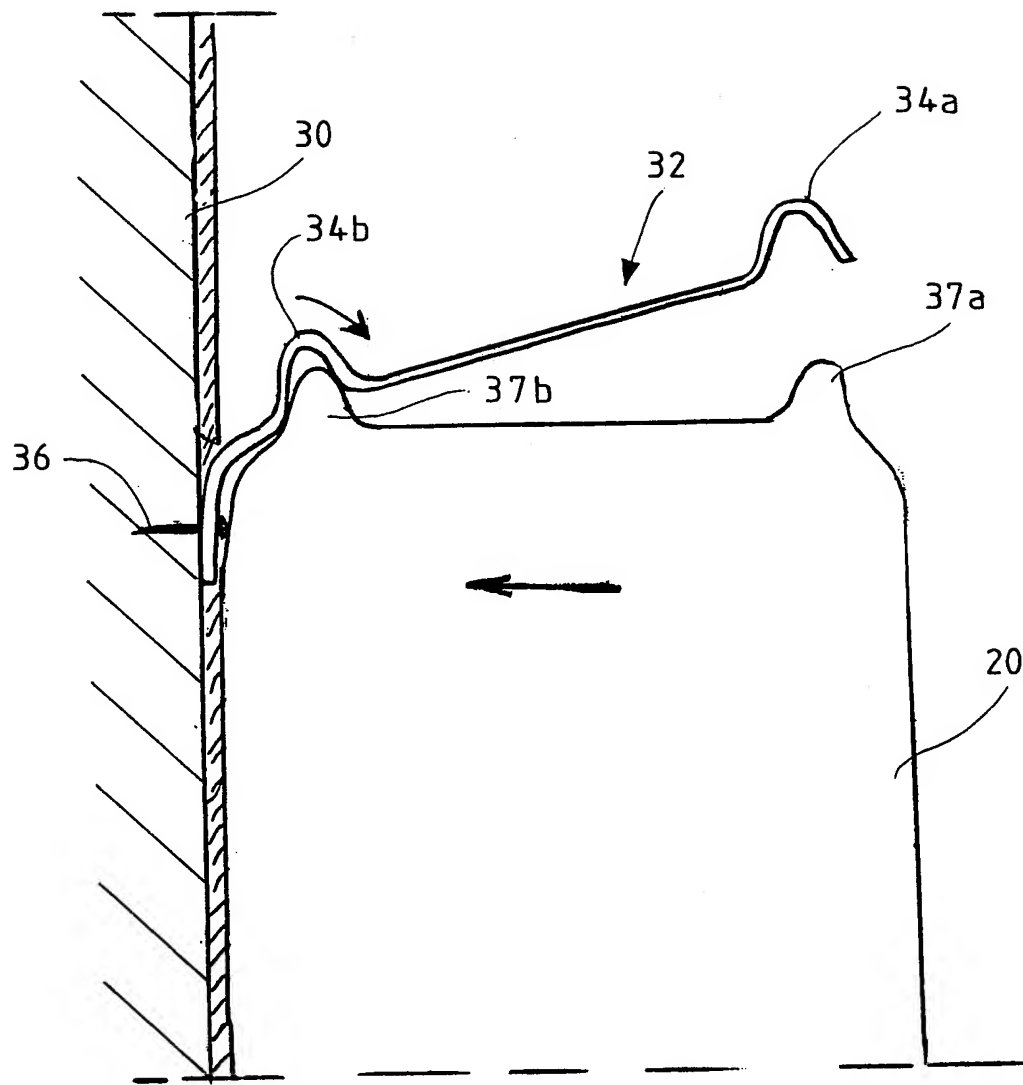


FIG. 11

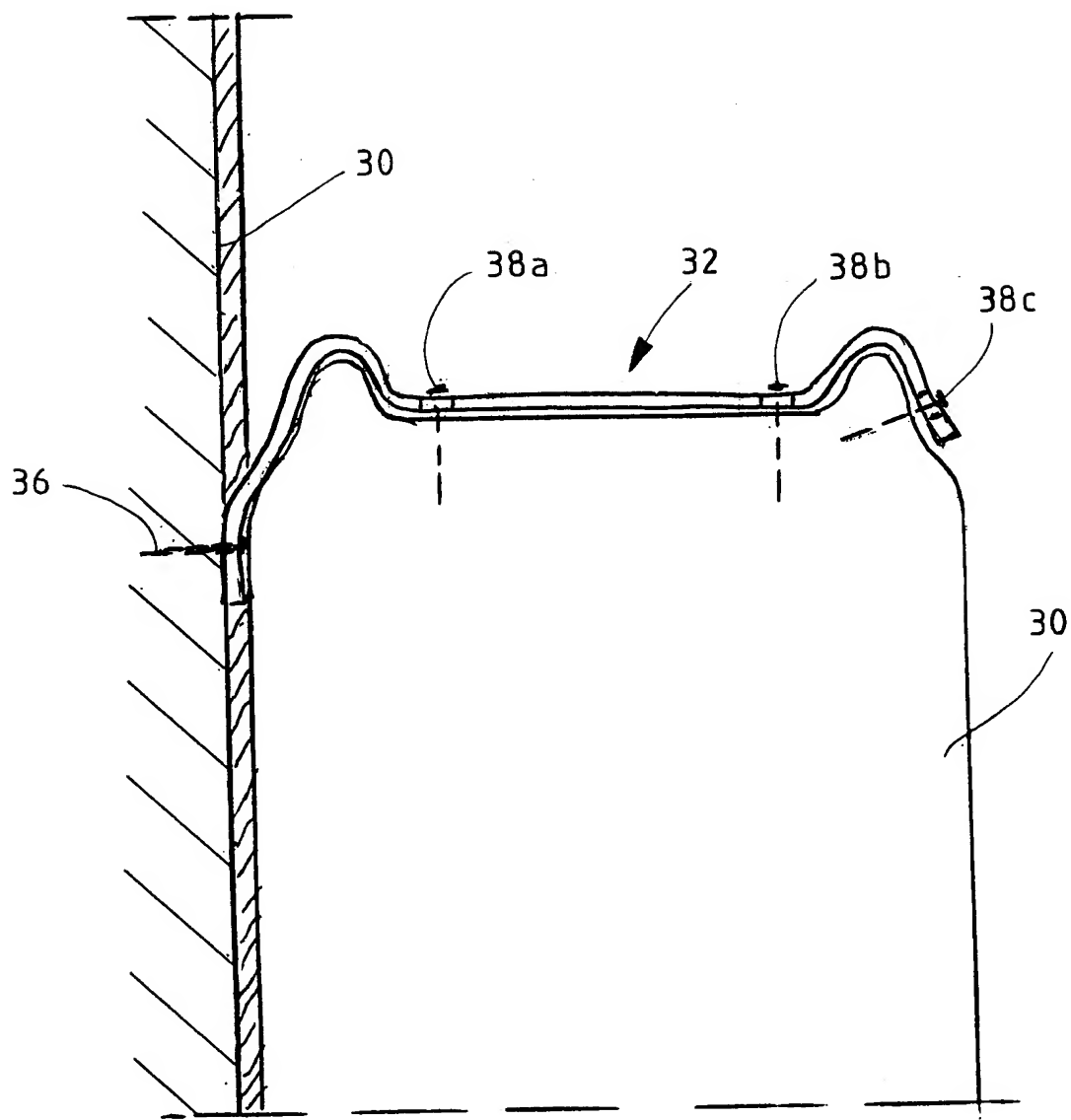


FIG. 12

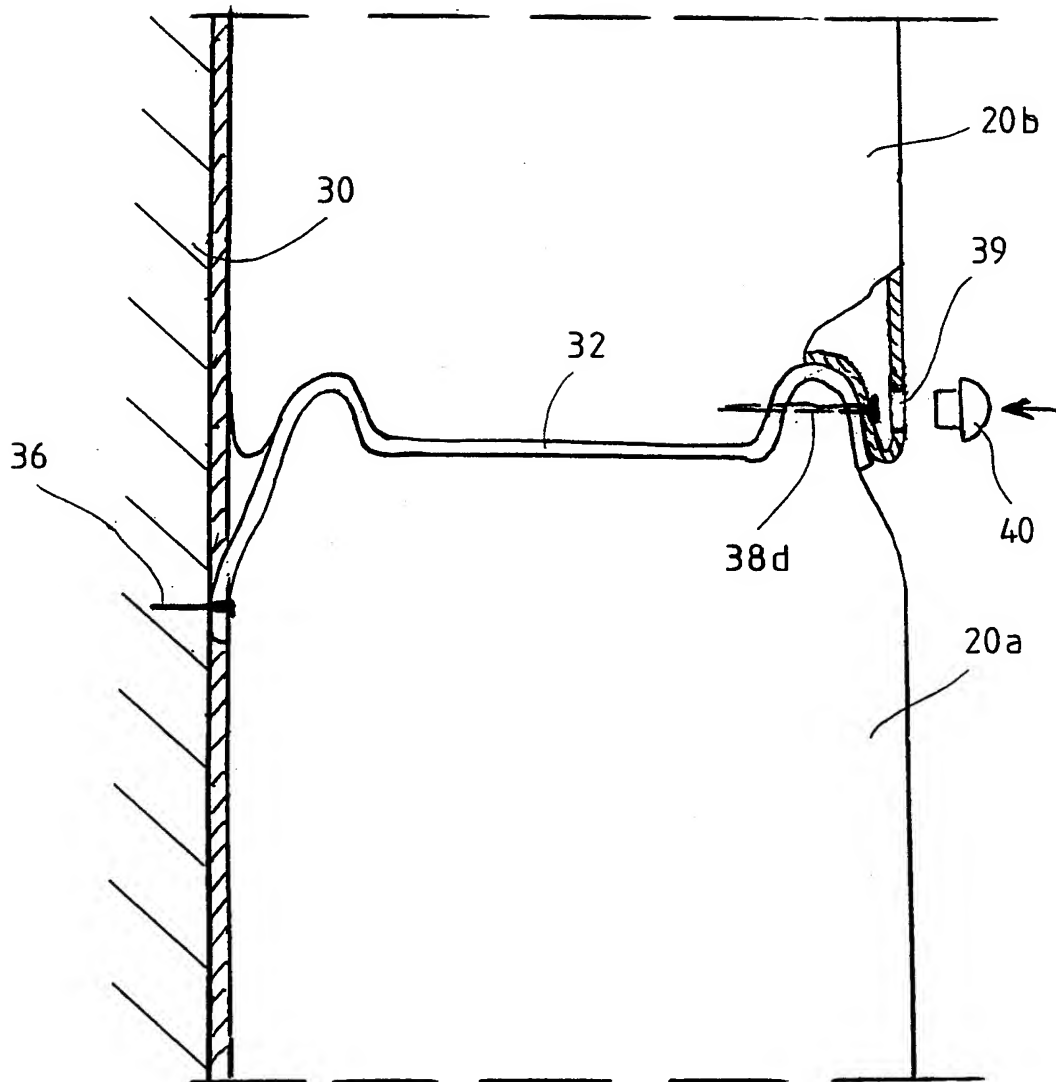


FIG. 13

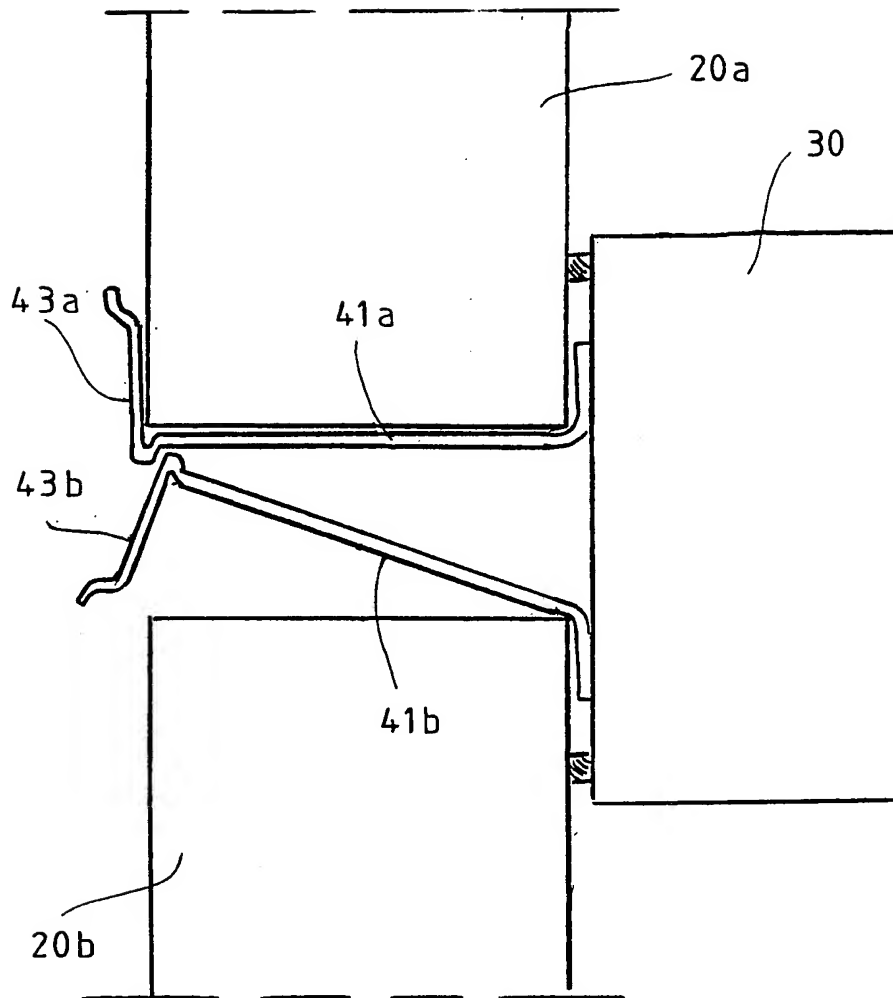


FIG. 14

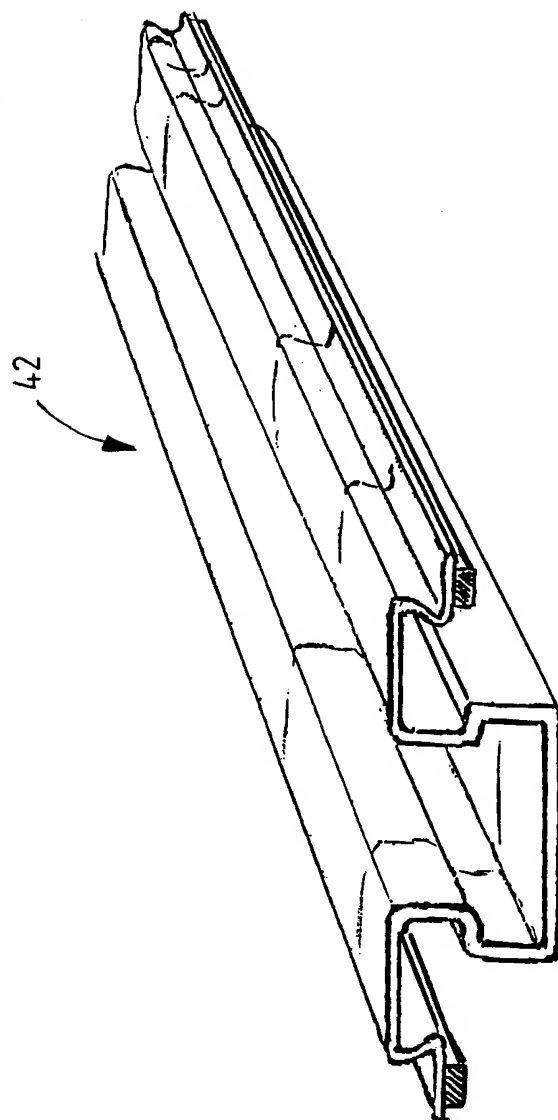


FIG. 15

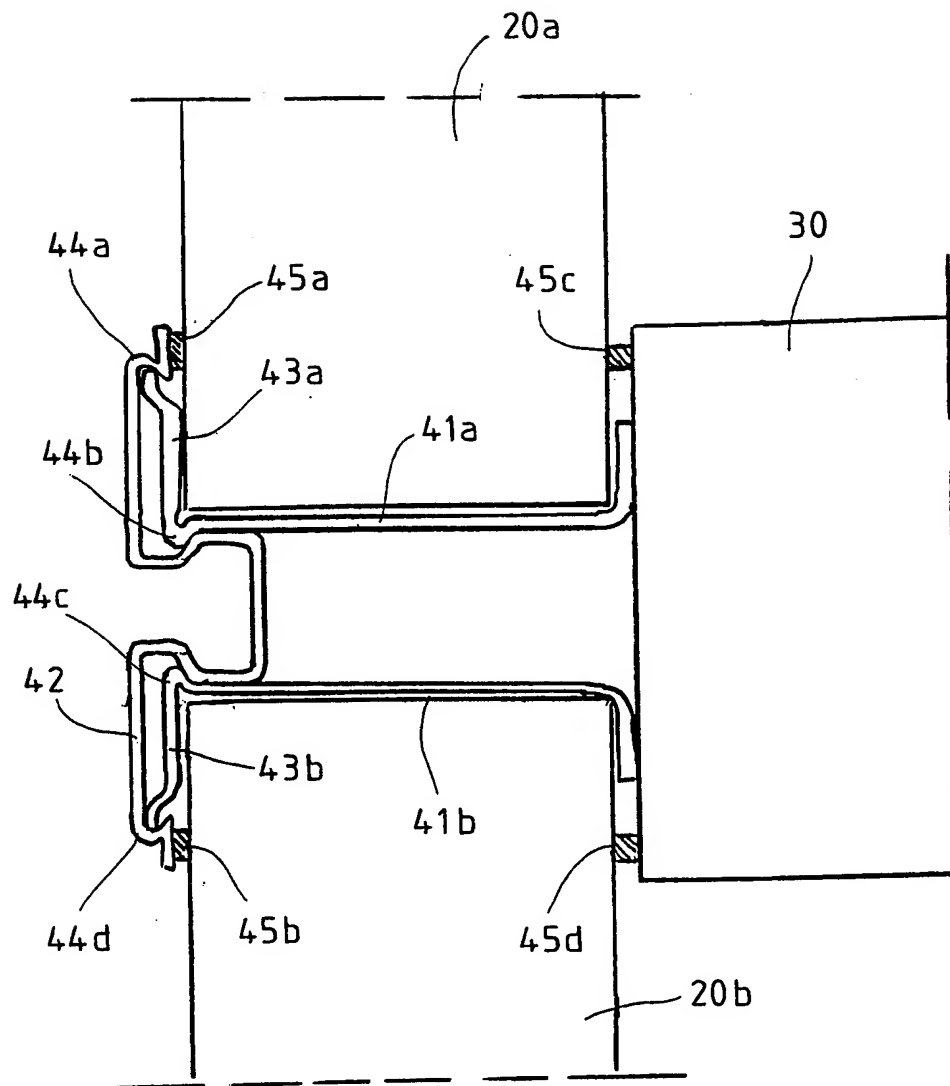


FIG. 16

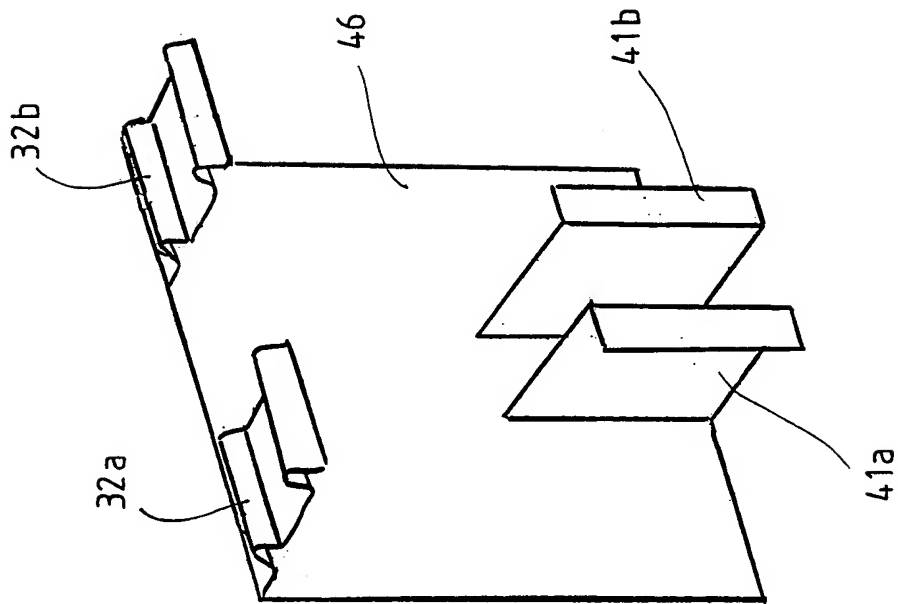


FIG. 17

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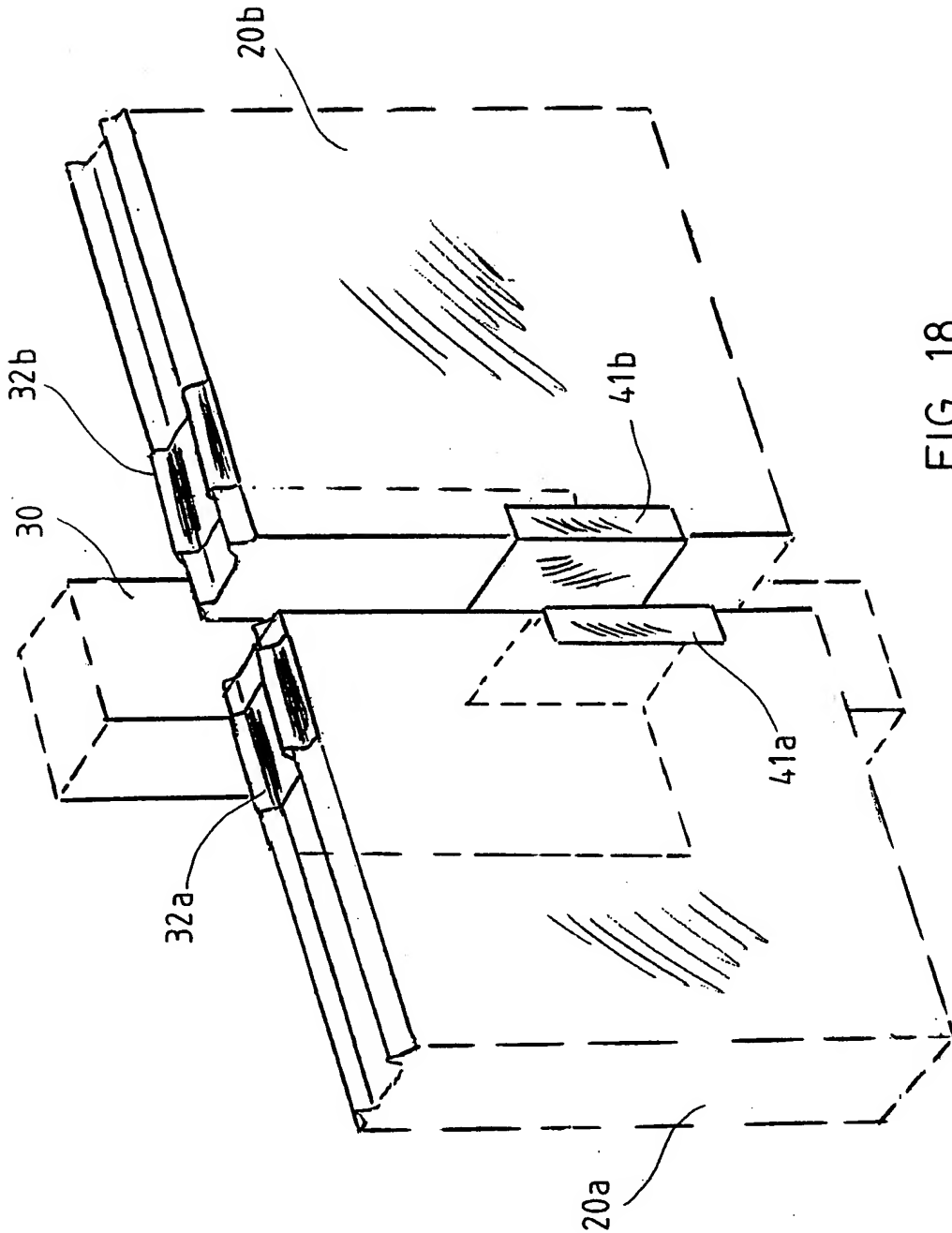


FIG. 18

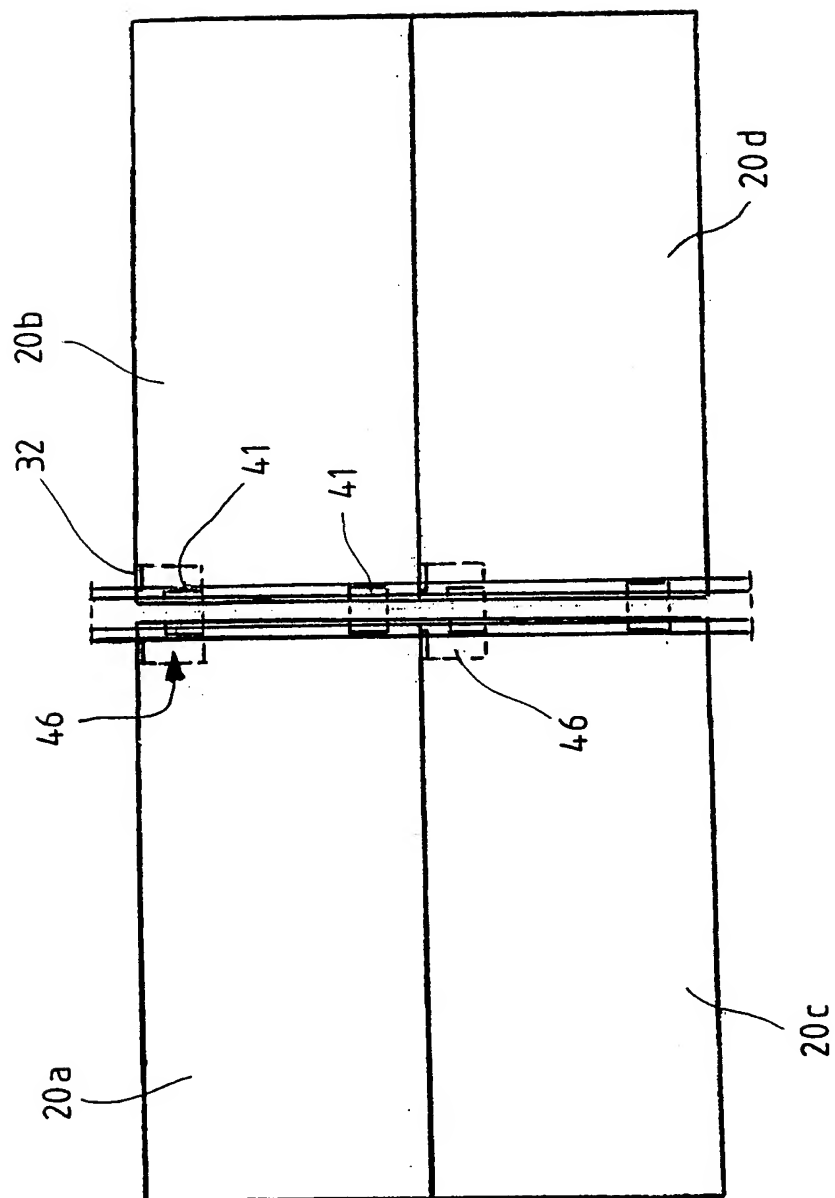
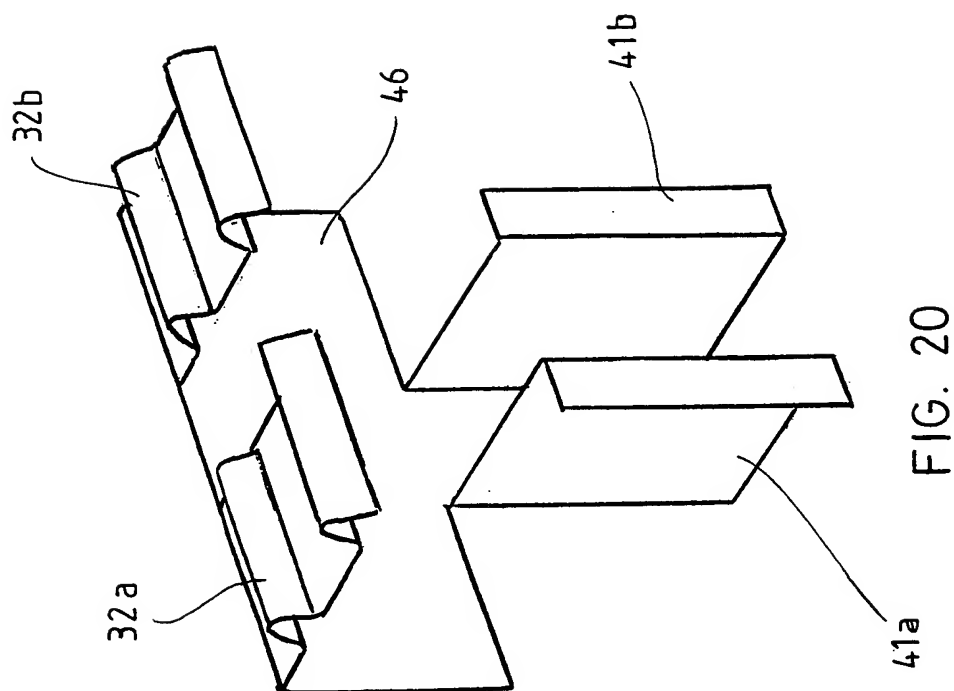


FIG. 19



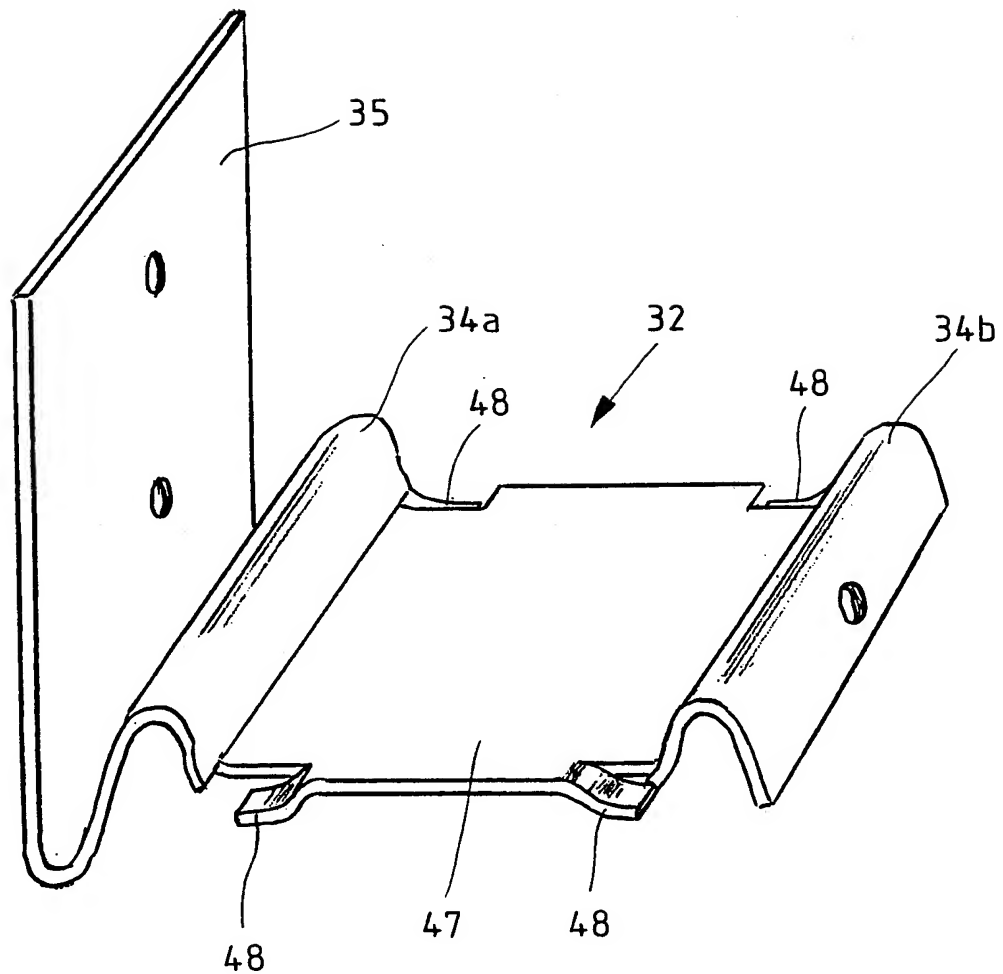


FIG. 21

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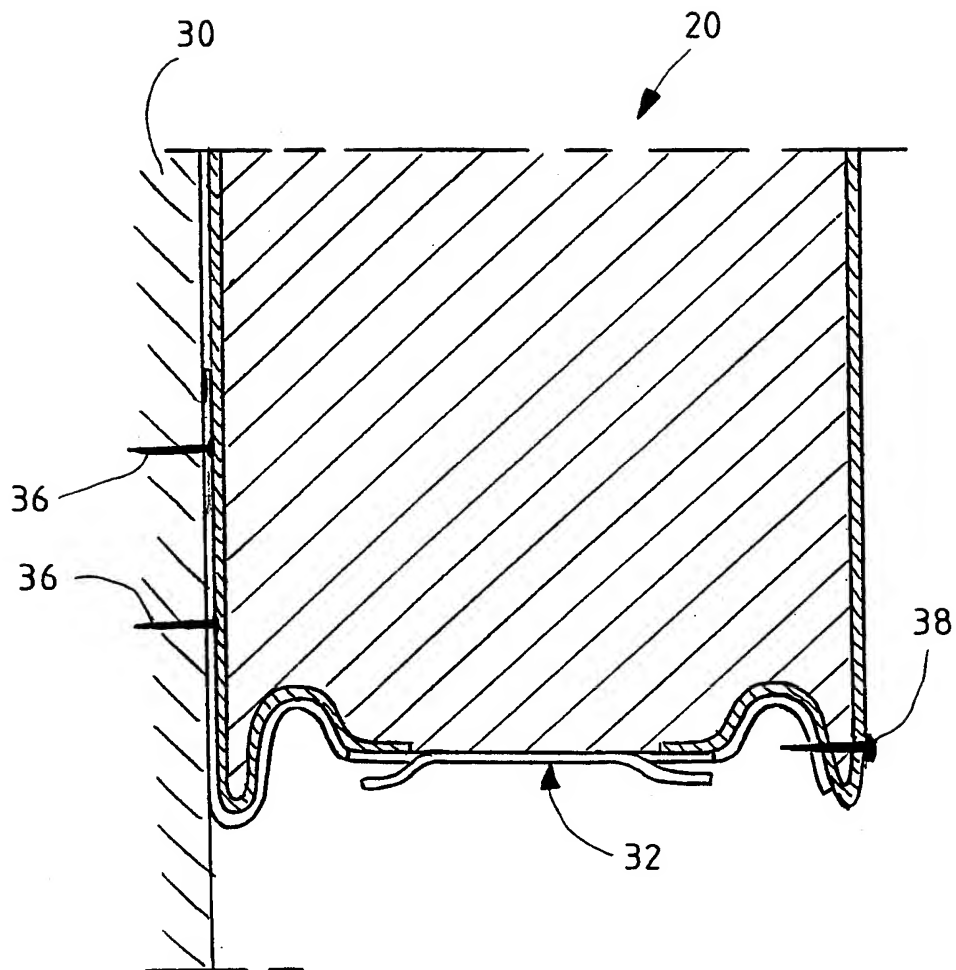


FIG. 22

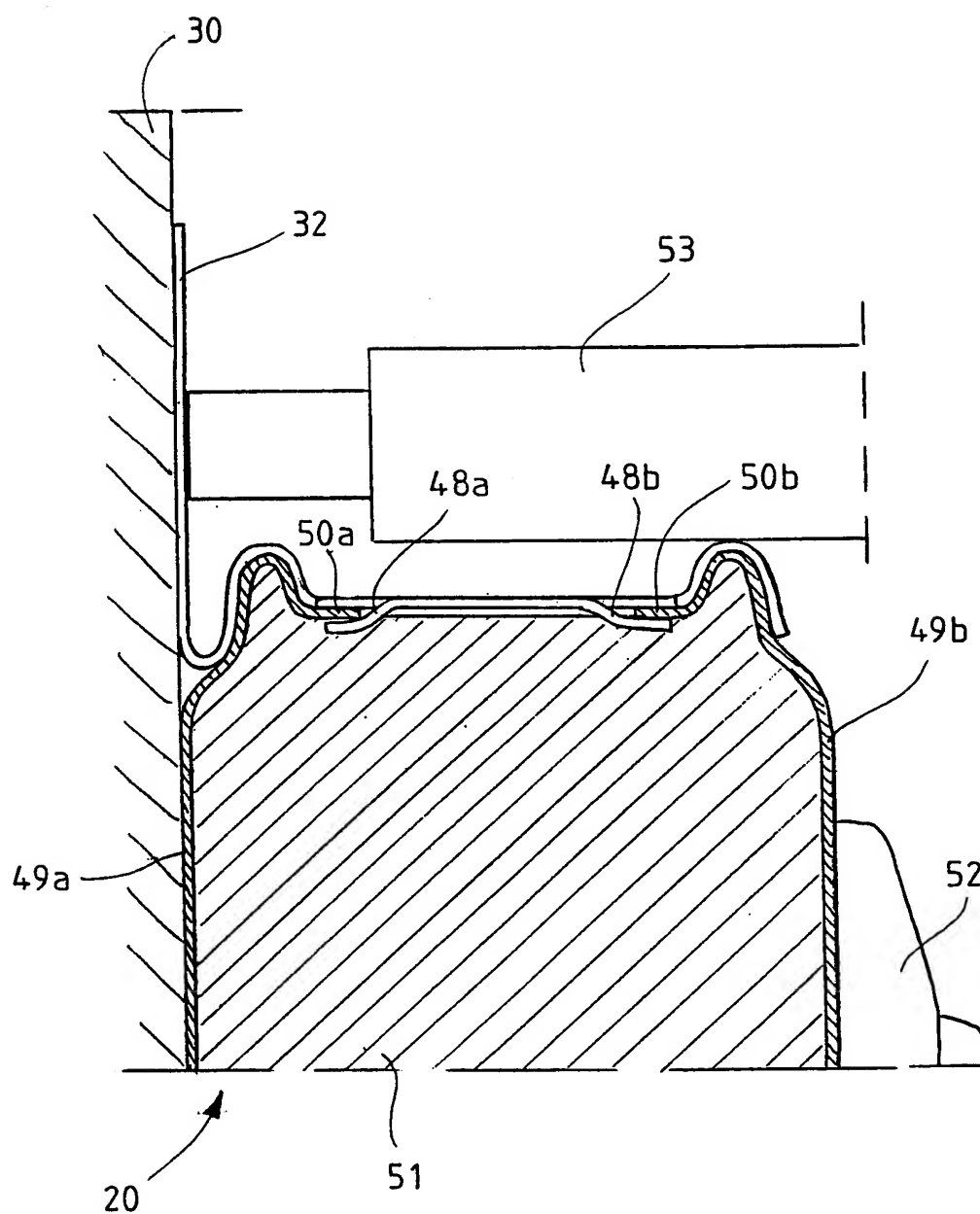


FIG. 23

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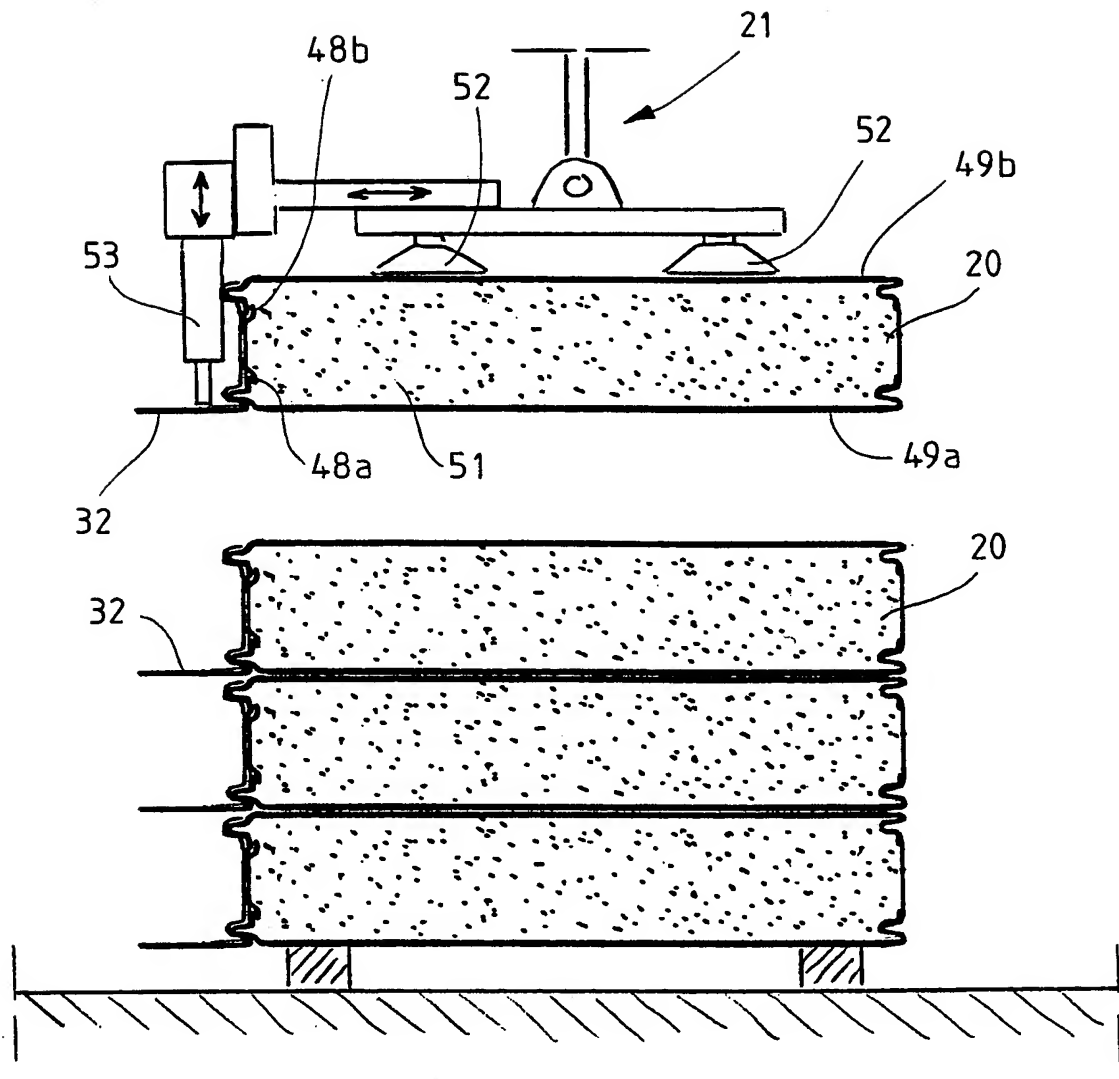


FIG. 24

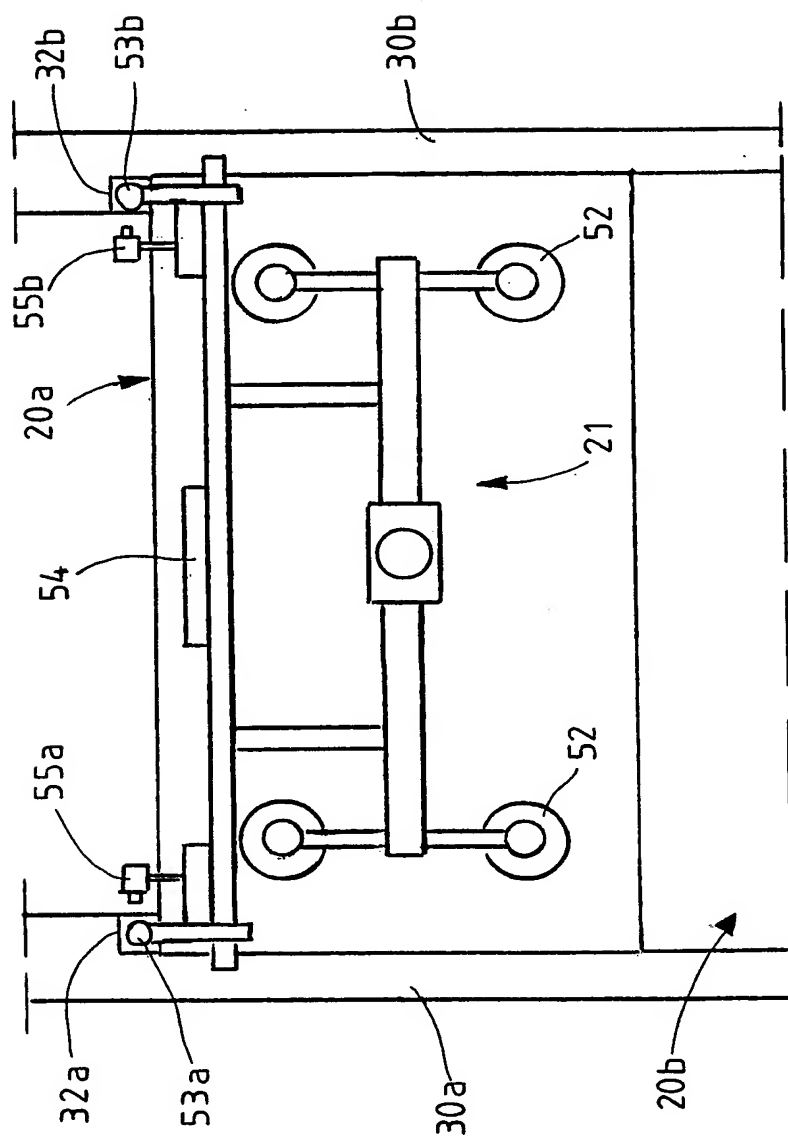


FIG. 25

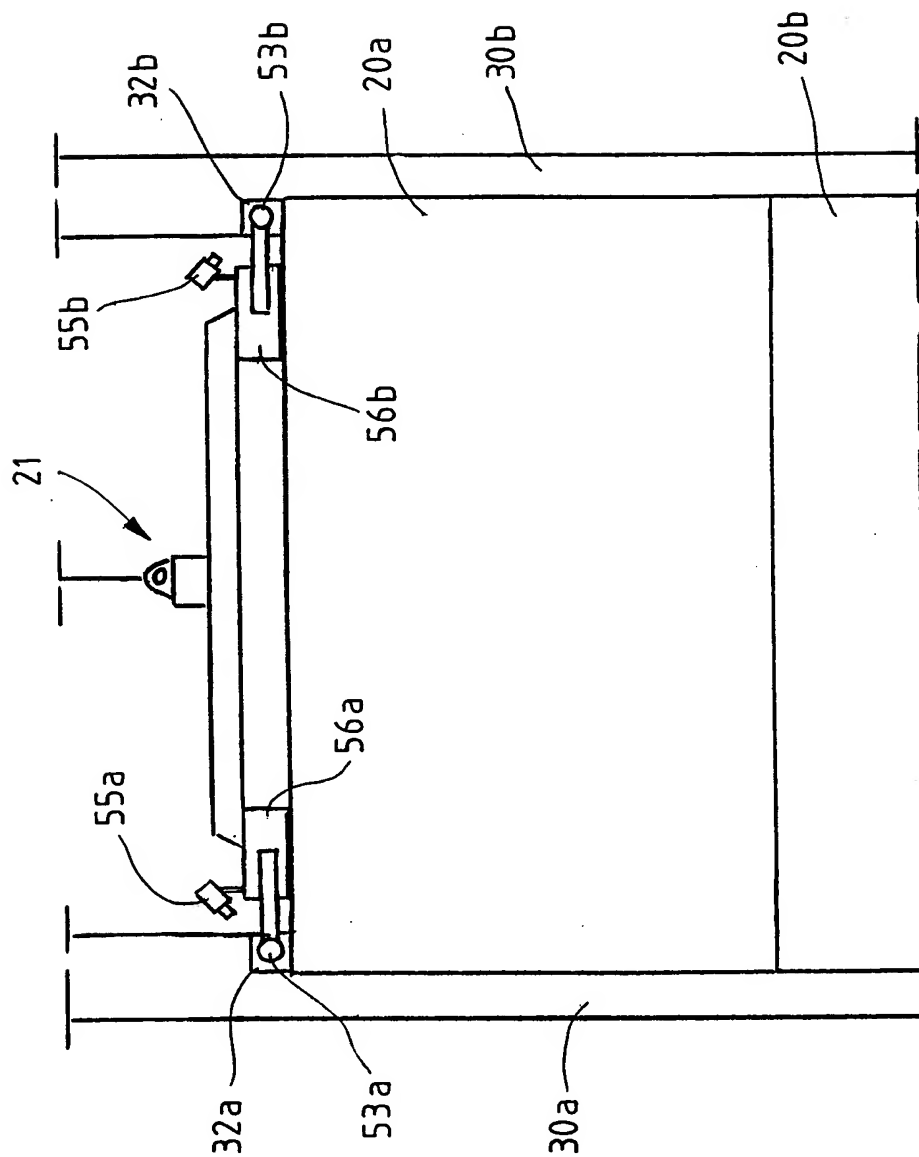


FIG. 26

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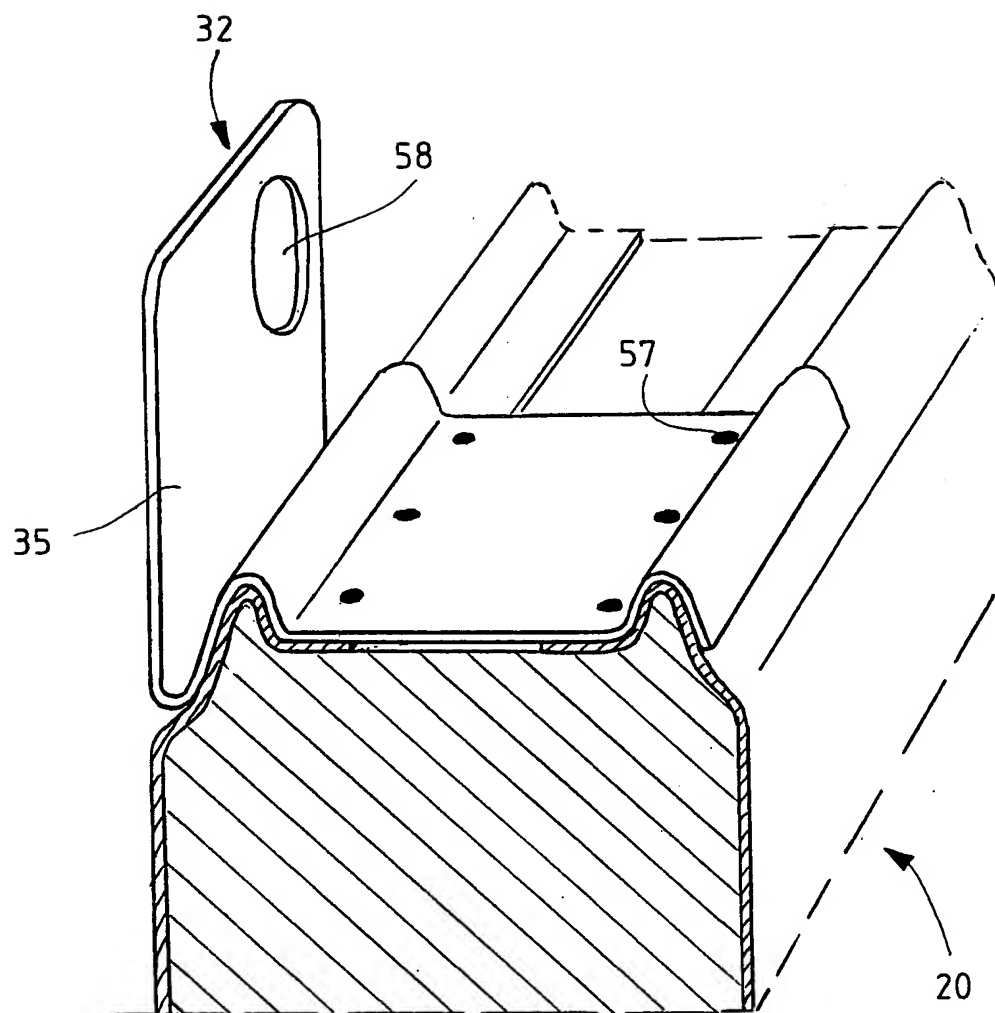


FIG. 28

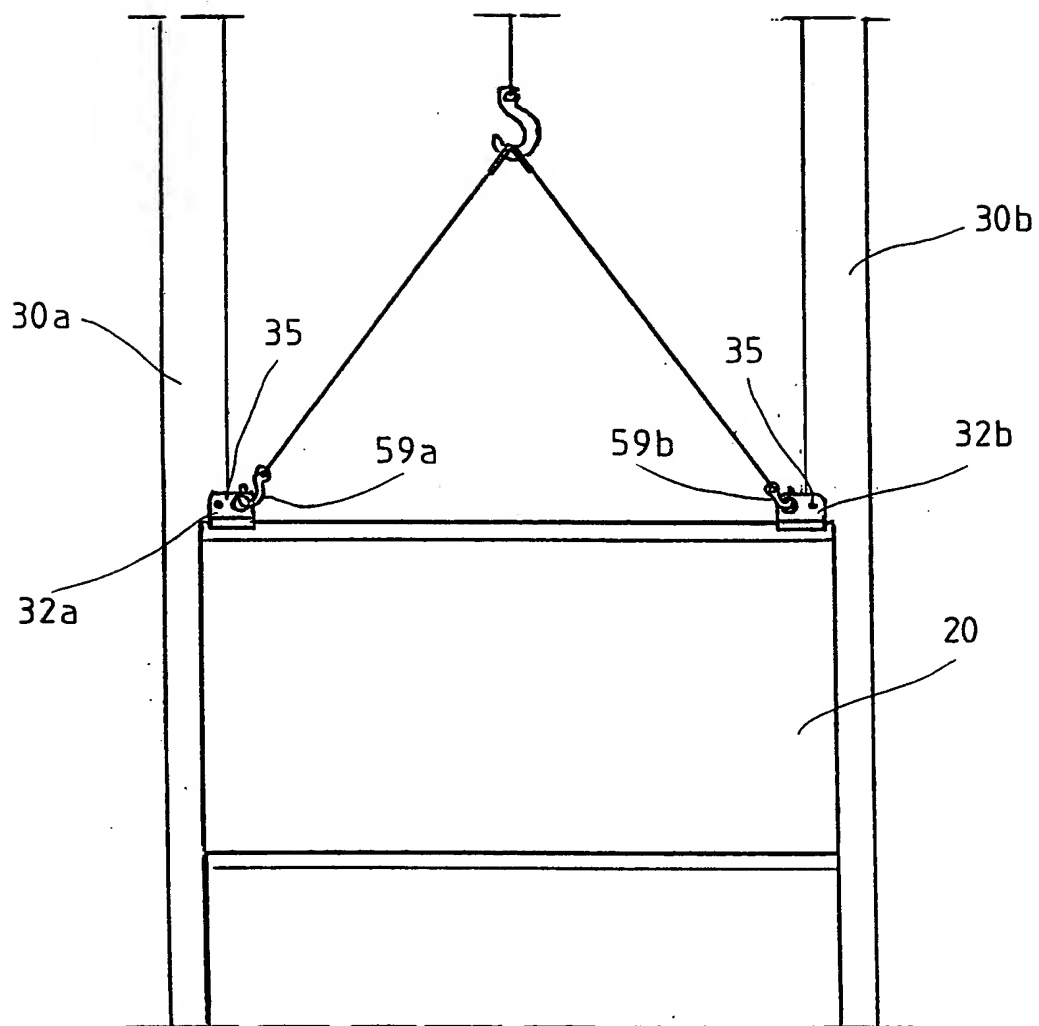


FIG. 29

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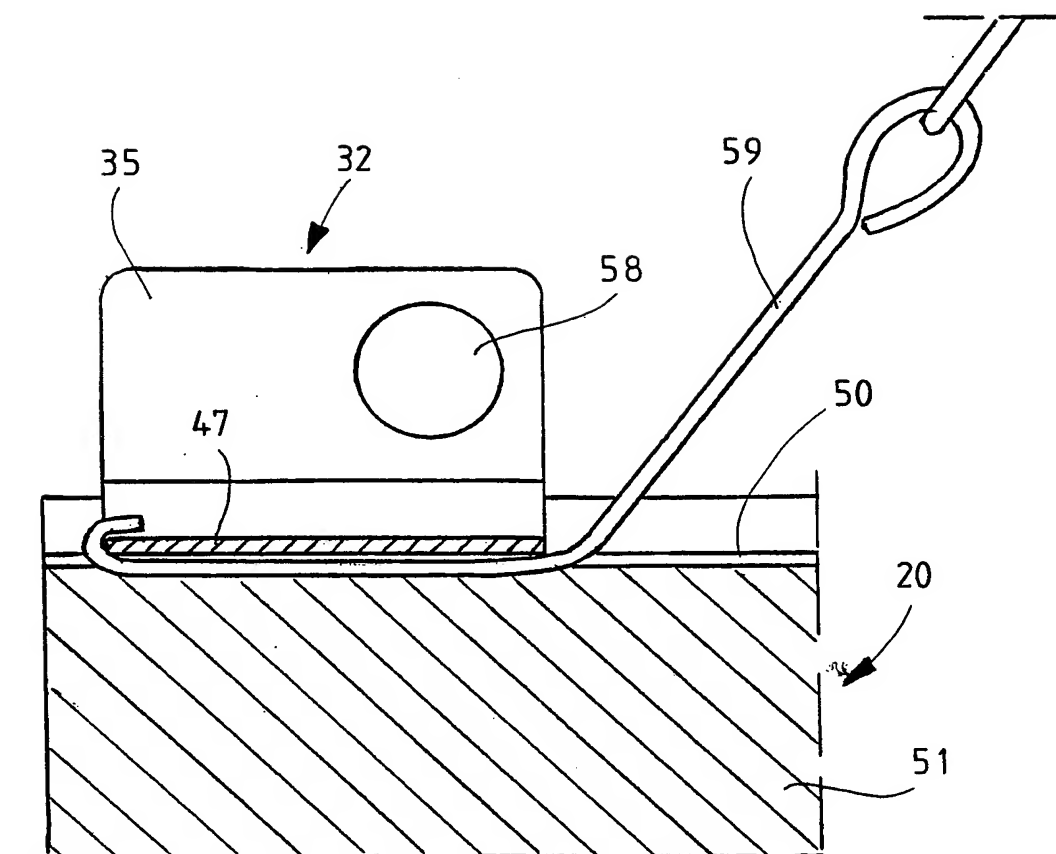


FIG. 30

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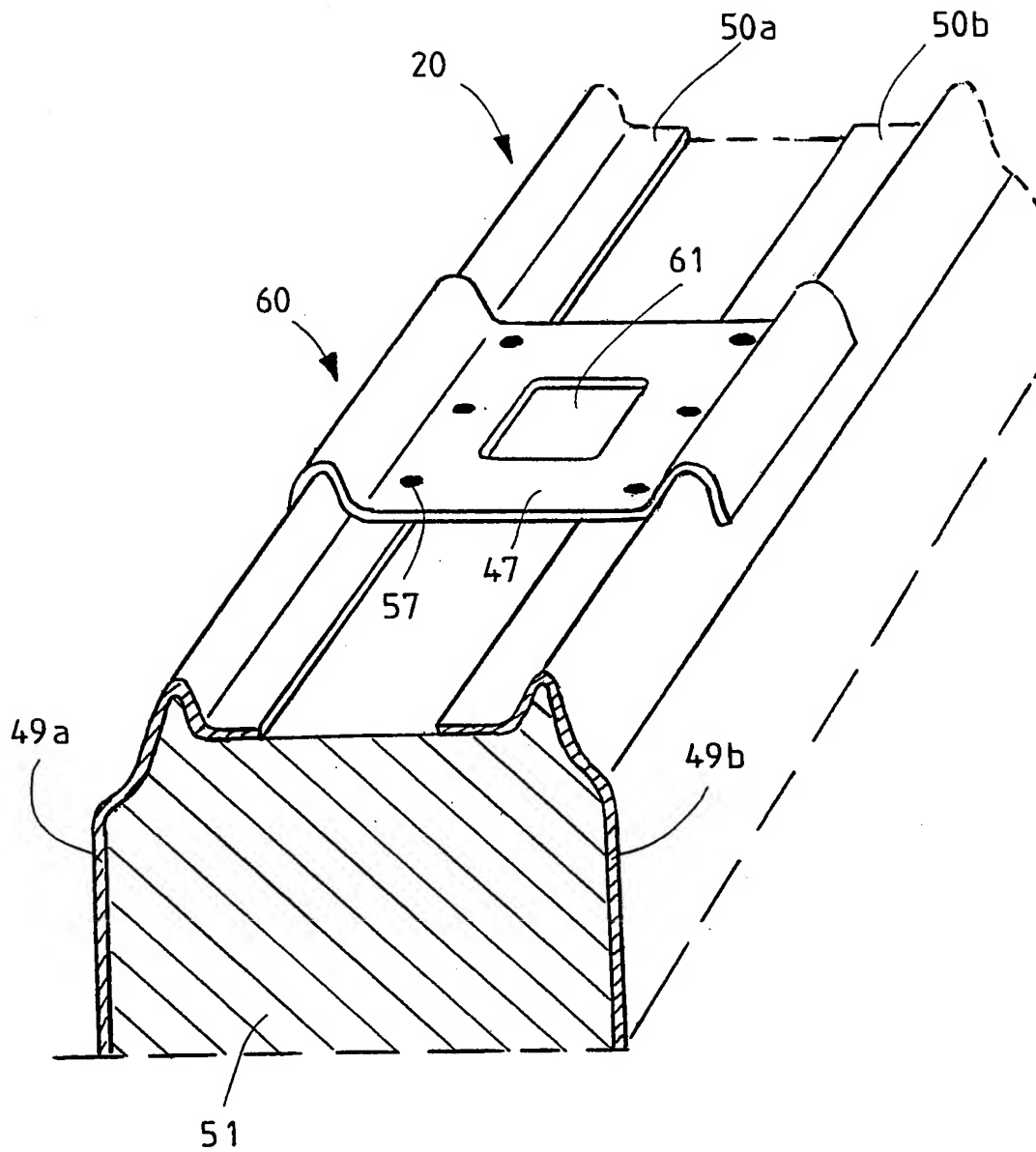


FIG. 31

INTERNATIONAL SEARCH REPORT

International application No.

PCT/IB 99/02035

A. CLASSIFICATION OF SUBJECT MATTER

IPC7: E04C 2/26, E04F 13/08, E04G 21/14

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC7: E04B, E04C, E04D, E04F, E04G

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE,DK,FI,NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	WO 9704190 A1 (PAROC OY AB), 6 February 1997 (06.02.97), figures 5,6, abstract --	1-9
A	DE 3231350 A1 (GSCHAIDER, P.), 1 March 1984 (01.03.84), claims 1,2 --	17-24
A	GB 2237300 A (YOSHIDA KOGYO KK), 1 May 1991 (01.05.91), figure 3(b),4,5, abstract --	1-37
A	WO 8912149 A1 (HOESCH STAHL AG), 14 December 1989 (14.12.89), figures 1,2, abstract -- -----	1-37

☐ Further documents are listed in the continuation of Box C.☒ See patent family annex.

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

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Date of the actual completion of the international search

10 May 2000

Date of mailing of the international search report

11 -05- 2000

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

02/12/99

PCT/IB 99/02035

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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